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ABSTRACT

Developed as part of the Marine Corps Institute (MCI) correspondence training program, this course on construction print reading is designed to provide Marines of all ranks and Military Occupation Specialities with the basic information to recognize the terms and symbols used in construction prints; it is adaptable for nonmilitary instruction. Introductory materials include specific information for MCI students, a course introduction, and a study guide (guidelines to complete the course). The 20-hour course contains four study units. Each study unit begins with a general objective. The study units are divided into numbered work units, each presenting one or more specific objectives. Contents of a work unit include a text and study questions/exercises. Answer keys are found at the end of each study unit. At the end of the course is a review lesson. Topics covered in the study units include principles and methods, plans and drawings (plot plan, foundation plan, floor plan, elevation drawings), structural information (scale and dimension, detail drawings, framing plan, types of frame construction), and utility, heating, and air conditioning (electrical plans, plumbing plans, heating and air conditioning). (YLB)

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UNITED STATES MARINE CORPS
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BOX 1775
ARLINGTON, VA. 22222 0001

13.44a
5 Dec 84

1. ORIGIN

MCI course 13.44a, Construction Print Reading, has been prepared by the Marine Corps Institute.

2. APPLICABILITY

This course is for instructional purposes only.

JMD Holladay

J. M. D. HOLLADAY
Lieutenant Colonel, U. S. Marine Corps
Deputy Director

INFORMATION

FOR

MCI STUDENTS

Welcome to the Marine Corps Institute training program. Your interest in self-improvement and increased professional competence is commendable.

Information is provided below to assist you in completing the course. Please read this guidance before proceeding with your studies.

1. MATERIALS

Check your course materials. You should have all the materials listed in the "Course Introduction." In addition you should have an envelope to mail your review lesson back to MCI for grading unless your review lesson answer sheet is of the self-mailing type. If your answer sheet is the pre-printed type, check to see that your name, rank, and social security number are correct. Check closely, your MCI records are kept on a computer and any discrepancy in the above information may cause your subsequent activity to go unrecorded. You may correct the information directly on the answer sheet. If you did not receive all your materials, notify your training NCO. If you are not attached to a Marine Corps unit, request them through the Hotline (autovon 288-4175 or commercial 202-433-4175).

2. LESSON SUBMISSION

The self-graded exercises contained in your course are not to be returned to MCI. Only the completed review lesson answer sheet should be mailed to MCI. The answer sheet is to be completed and mailed only after you have finished all of the study units in the course booklet. The review lesson has been designed to prepare you for the final examination.

It is important that you provide the required information at the bottom of your review lesson answer sheet if it does not have your name and address printed on it. In courses in which the work is submitted on blank paper or printed forms, identify each sheet in the following manner:

DOE, John J. Sgt 332-11-9999
08.4g, Forward Observation
Review Lesson
Military or office address
(RUC number, if available)

Submit your review lesson on the answer sheet and/or forms provided. Complete all blocks and follow the directions on the answer sheet for mailing. Otherwise, your answer sheet may be delayed or lost. If you have to interrupt your studies for any reason and find that you cannot complete your course in one year, you may request a single six month extension by contacting your training NCO, at least one month prior to your course completion deadline date. If you are not attached to a Marine Corps unit you may make this request by letter. Your commanding officer is notified monthly of your status through the monthly Unit Activity Report. In the event of difficulty, contact your training NCO or MCI immediately.

3. MAIL-TIME DELAY

Presented below are the mail-time delays that you may experience between the mailing of your review lesson and its return to you.

	TURNAROUND MAIL TIME	MCI PROCESSING TIME	TOTAL NUMBER DAYS
EAST COAST	16	5	21
WEST COAST	16	5	21
FPO NEW YORK	18	5	23
FPO SAN FRANCISCO	22	5	27

You may also experience a short delay in receiving your final examination due to administrative screening required at MCI.

4. GRADING SYSTEM

LESSONS			EXAMS	
GRADE	PERCENT	MEANING	GRADE	PERCENT
A	94-100	EXCELLENT	A	94-100
B	86-93	ABOVE AVERAGE	B	86-93
C	78-85	AVERAGE	C	78-85
D	70-77	BELOW AVERAGE	D	65-77
NL	BELOW 70	FAILING	F	BELOW 65

You will receive a percentage grade for your review lesson and for the final examination. A review lesson which receives a score below 70 is given a grade of NL (no lesson). It must be resubmitted and PASSED before you will receive an examination. The grade attained on the final exam is your course grade, unless you fail your first exam. Those who fail their first exam will be sent an alternate exam in which the highest grade possible is 65%. Failure of the alternate will result in failure of the course.

5. FINAL EXAMINATION

ACTIVE DUTY PERSONNEL: When you pass your REVIEW LESSON, your examination will be mailed automatically to your commanding officer. The administration of MCI final examinations must be supervised by a commissioned or warrant officer or a staff NCO.

OTHER PERSONNEL: Your examination may be administered and supervised by your supervisor.

6. COMPLETION CERTIFICATE

The completion certificate will be mailed to your commanding officer and your official records will be updated automatically. For non Marines, your completion certificate is mailed to your supervisor.

7. RESERVE RETIREMENT CREDITS

Reserve retirement credits are awarded to inactive duty personnel only. Credits awarded for each course are listed in the "Course Introduction." Credits are only awarded upon successful completion of the course. Reserve retirement credits are not awarded for MCI study performed during drill periods if credits are also awarded for drill attendance.

8. DISENROLLMENT

Only your commanding officer can request your disenrollment from an MCI course. However, an automatic disenrollment occurs if the course is not completed (including the final exam) by the time you reach the CCD (course completion deadline) or the ACCD (adjusted course completion deadline) date. This action will adversely affect the unit's completion rate.

9. ASSISTANCE

Consult your training NCO if you have questions concerning course content. Should he/she be unable to assist you, MCI is ready to help you whenever you need it. Please use the Student Course Content Assistance Request Form (ISD-1) attached to the end of your course booklet or call one of the AUTOVON telephone numbers listed below for the appropriate course writer section.

PERSONNEL/ADMINISTRATION	288-3259
COMMUNICATIONS/ELECTRONICS/AVIATION	
NBC/INTELLIGENCE	288-3604
INFANTRY	288-3611
ENGINEER/MOTOR TRANSPORT	288-2275
SUPPLY/FOOD SERVICES/FISCAL	288-2285
TANKS/ARTILLERY/INFANTRY WEAPONS REPAIR	
LOGISTICS/EMBARKATION/MAINTENANCE MANAGEMENT/	
ASSAULT AMPHIBIAN VEHICLES	288-2290

For administrative problems use the UAR or call the MCI HOTLINE: 288-4175.

For commercial phone lines, use area code 202 and prefix 433 instead of 288.

SOURCE MATERIALS

TM 5-704	Construction Print Reading In the Field 1969
SRT 1671-2-1	Blueprint Reading, MCES
	Designs for Low Cost Wood Homes, 1978. U. S. Department of Agriculture, Forest Service
	Vertical Structures, 1978, U. S. Army Engineers School, Student Workbook
	Blueprint Reading and Sketching, 1968, Naval Correspondence Courses Center

CONSTRUCTION PRINT READING

Course Introduction

CONSTRUCTION PRINT READING is designed to provide Marines of all ranks and MOS with the basic information to recognize the terms and symbols used in construction prints. As it progresses, the course provides Marines with instructions for reading blueprints of construction sites, and finally, with information on how to use the architect's scale.

ADMINISTRATIVE INFORMATION

ORDER OF STUDIES

Study Unit Number	Study Hours	Subject Matter
1	4	Principles and Methods
2	4	Plans and Drawings
3	4	Structural Information
4	4	Utility, Heating, and Air Conditioning
	2	REVIEW LESSON
	2	FINAL EXAMINATION
	20	

RESERVE RETIREMENT CREDITS:	7
EXAMINATION:	Supervised final examination without text or notes; time limit, 2 hours.
MATERIAL:	MCI 13.44a, Construction Print Reading Review lesson and answer sheet
RETURN OF MATERIAL:	Students who successfully complete this course are permitted to keep the course materials. Students disenrolled for inactivity or at the request of their commanding officers will return all course materials.

HOW TO TAKE THIS COURSE

This course contains 4 study units. Each study unit begins with a general objective which is a statement of what you should learn from that study unit. The study units are divided into numbered work units, each presenting one or more specific objective. Read the objective(s) and then the work unit text. At the end of the work unit text are study questions which you should be able to answer without referring to the text of the work unit. After answering the questions, check your answers against the correct ones listed at the end of the study unit. If you miss any of the questions, you should restudy the text of the work unit until you understand the correct response. When you have mastered one study unit, move on to the next. After you have completed all study units, complete the review lesson and take it to your training officer or NCO for mailing to MCI. MCI will mail the final examination to your training officer or NCO when you pass the review lesson.

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Special views	1-3	1-12
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Handling prints	1-5	1-21
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Summary review		1-29

Study Unit 2. PLANS AND DRAWINGS

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Section II. Foundation Plan

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Wall foundations	2-4	2-10

Section III. Floor Plans

	Work Unit	Page
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Floor plan abbreviations	2-6	2-20
Reading floor plans	2-7	2-22

Section IV. Elevation Drawings

	Work Unit	Page
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Elevation abbreviations	2-9	2-29
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Study Unit 3. STRUCTURAL INFORMATION

Section I. Scale and Dimension

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The architect's scale	3-2	3-3
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	Work Unit	Page
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Section views	3-8	3-29

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Roof framing plan	3-10	3-36
Wall framing plan	3-11	3-37

Work Unit Page

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Balloon framing 3-13 3-40
Summary review 3-42

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Section II. Plumbing Plans

Plumbing symbols 4-4 4-13
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Section III. Heating and Air Conditioning

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MARINE CORPS INSTITUTE

STUDY GUIDE

Welcome to the Marine Corps Institute correspondence training program. By enrolling in this course, you have shown a desire to improve the skills you need for effective job performance, and MCI has provided materials to help you achieve your goal. Now all you need is to develop your own method for using these materials to best advantage.

The following guidelines present a four-part approach to completing your MCI course successfully:

1. Make a "reconnaissance" of your materials;
2. Plan your study time and choose a good study environment;
3. Study thoroughly and systematically;
4. Prepare for the final exam.

I. MAKE A "RECONNAISSANCE" OF YOUR MATERIALS

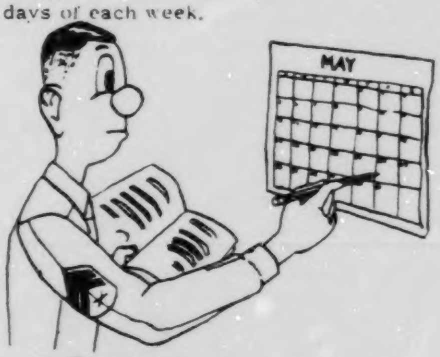
Begin with a look at the course introduction page. Read the COURSE INTRODUCTION to get the "big picture" of the course. Then read the MATERIALS section near the bottom of the page to find out which text(s) and study aids you should have received with the course. If any of the listed materials are missing, see Information for MCI Students to find out how to get them. If you have everything that is listed, you are ready to "reconnoiter" your MCI course.

Read through the table(s) of contents of your text(s). Note the various subjects covered in the course and the order in which they are taught. Leaf through the text(s) and look at the illustrations. Read a few work unit questions to get an idea of the types that are asked. If MCI provides other study aids, such as a slide rule or a plotting board, familiarize yourself with them. Now, get down to specifics!

II. PLAN YOUR STUDY TIME AND CHOOSE A GOOD STUDY ENVIRONMENT

From looking over the course materials, you should have some idea of how much study you will need to complete this course. But "some idea" is not enough. You need to work up a personal study plan: the following steps should give you some help.

Ⓐ Get a calendar and mark those days of the week when you have time free for study. Two study periods per week, each lasting 1 to 3 hours, are suggested for completing the minimum two study units required each month by MCI. Of course, work and other schedules are not the same for everyone. The important thing is that you schedule a regular time for study on the same days of each week.



Ⓑ Read the course introduction page again. The section marked ORDER OF STUDIES tells you the number of study units in the course and the approximate number of study hours you will need to complete each study unit. Plug these study hours into your schedule. For example, if you set aside two 2-hour study periods each week and the ORDER OF STUDIES estimates 2 study hours for your first study unit, you could easily schedule and complete the first study unit in one study period. On your calendar you would mark "Study Unit 1" on the appropriate day. Suppose that the second study unit of your course requires 3 study hours. In that case, you would divide the study unit in half and work on each half during a separate study period. You would mark your calendar accordingly. Indicate on your calendar exactly when you plan to work on each study unit for the entire course. Do not forget to schedule one or two study periods to prepare for the final exam.

Ⓒ Stick to your schedule.

Besides planning your study time, you should also choose a study environment that is right for you. Most people need a quiet place for study, like a library or a reading lounge; other people study better where there is background music; still others prefer to study out-of-doors. You must choose your study environment carefully so that it fits your individual needs.

III. STUDY THOROUGHLY AND SYSTEMATICALLY

Armed with a workable schedule and situated in a good study environment you are now ready to attack your course study unit by study unit. To begin, turn to the first page of study unit 1. On this page you will find the study unit objective, a statement of what you should be able to do after completing the study unit.

DO NOT begin by reading the work unit questions and flipping through the text for answers. If you do so, you will prepare to fail, not pass, the final exam. Instead, proceed as follows:

Ⓐ Read the objective for the first work unit and then read the work unit text carefully. Make notes on the ideas you feel are important.

Ⓑ Without referring to the text, answer the questions at the end of the work unit.

Ⓒ Check your answers against the correct ones listed at the end of the study unit.

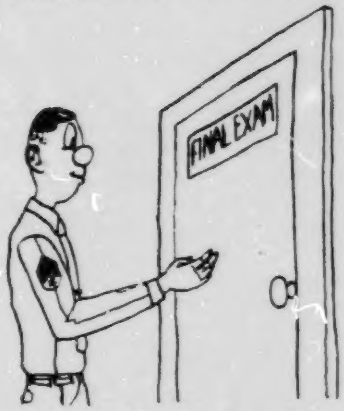
Ⓓ If you miss any of the questions, restudy the work unit until you understand the correct response.

Ⓔ Go on to the next work unit and repeat steps Ⓐ through Ⓓ until you have completed all the work units in the study unit.

Follow the same procedure for each study unit of the course. If you have problems with the text or work unit questions that you cannot solve on your own, ask your section OIC or NCOIC for help. If he cannot aid you, request assistance from MCI on the Student Course Content Assistance Request included with this course.

When you have finished all the study units, complete the course review lesson. Try to answer each question without the aid of reference materials. However, if you do not know an answer, look it up. When you have finished the lesson, take it to your training officer or NCO for mailing to MCI. MCI will grade it and send you a feedback sheet listing course references for any questions that you miss.

IV. PREPARE FOR THE FINAL EXAM



How do you prepare for the final exam? Follow these four steps:

Ⓐ Review each study unit objective as a summary of what was taught in the course.

Ⓑ Reread all portions of the text that you found particularly difficult.

Ⓒ Review all the work unit questions, paying special attention to those you missed the first time around.

Ⓓ Study the course review lesson, paying particular attention to the questions you missed.

If you follow these simple steps, you should do well on the final. GOOD LUCK!

BEST COPY AVAILABLE

STUDY UNIT 1

PRINCIPLES AND METHODS

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL BE ABLE TO IDENTIFY THE TERMS AND SYMBOLS USED IN CONSTRUCTION PRINTS, AS WELL AS DIMENSIONS, VIEWS, AND PROTECTIONS. YOU WILL BE ABLE TO NAME BOTH THE PARTS OF A PRINT AND THE TYPES OF PRINTS.

A picture is worth a thousand words. Man has used pictures as a means of communication for many years. It would be almost impossible for an engineer or an inventor to describe the size and shape of a simple object without a drawing of some kind. For example, if an engineer designed a simple object such as the one shown in figure 1-1, he would have difficulty in conveying his idea of how to develop it into the object illustrated without a drawing giving specific instructions such as shape, size, and construction specifications to be followed by the person in charge of the job. A working drawing showing all these instructions is illustrated in figure 1-2.

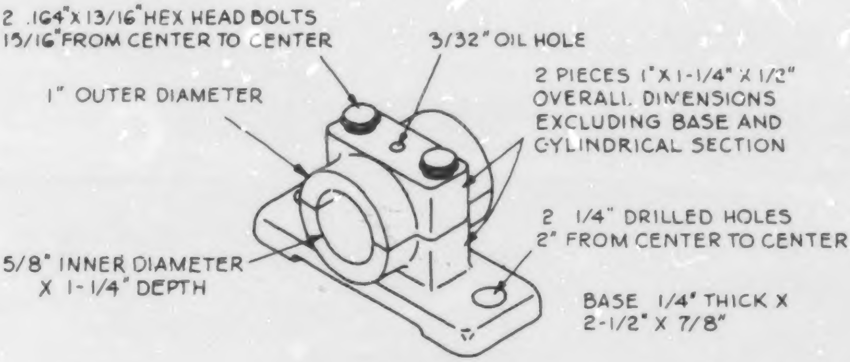

2 .164"X13/16" HEX HEAD BOLTS
15/16" FROM CENTER TO CENTER
3/32" OIL HOLE
1" OUTER DIAMETER
2 PIECES 1"X1-1/4"X1/2"
OVERALL DIMENSIONS
EXCLUDING BASE AND
CYLINDRICAL SECTION
2 1/4" DRILLED HOLES
2" FROM CENTER TO CENTER
5/8" INNER DIAMETER
X 1-1/4" DEPTH
BASE 1/4" THICK X
2-1/2" X 7/8"

Fig 1-1. Engineer's sketch.

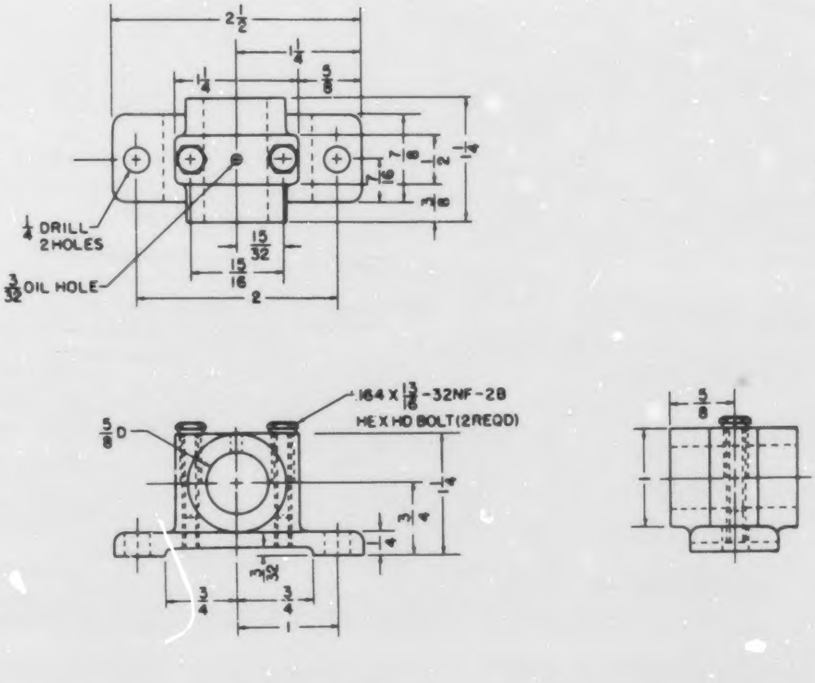

2 1/2
1 1/4
1 1/4
5/8
7/8
7/16
1/2
1 1/4
3/8
1/4 DRILL 2 HOLES
3/32 OIL HOLE
15/32
15/16
2
.164 X 13/16 -32NF-2B
HEX HD BOLT (2 REQD)
5/8 D
1 1/4
3/4
1/4
3/32
3/4
3/4
1
5/8
1

Fig 1-2. Working drawing.

Drawing or sketching is the universal language used by engineers, technicians, and skilled craftsmen. Whether the drawing is made freehand or by the use of drawing instruments (mechanical drawing), it must convey all the necessary information to the individual who will fabricate and assemble the object whether it be a building, ship, aircraft, or mechanical device.

Work Unit 1-1. LINE CONVENTIONS

IDENTIFY ANY FIVE OF THE TWELVE LINE CONVENTIONS.

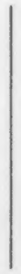
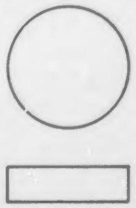
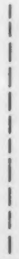
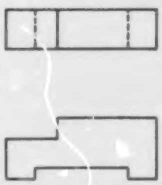
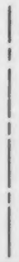
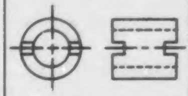
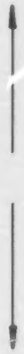
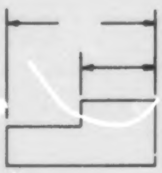
To include all the necessary information on a drawing in a meaningful manner, different types and weights of lines are used to represent the features of the object. The meaning of a line with certain characteristics has been standardized, and will be the same on any drawing. These line conventions must be understood in order to read drawings. The line conventions most often encountered in construction prints are presented in this work unit.

Visible lines. A heavyweight unbroken line is used for the primary feature of a drawing. For drawings of objects, this line convention represents the edges, the intersection [illegible] surfaces, or the surface lim[illegible] visible from the viewing angle [illegible] drawing. This line is often called [illegible] outline.

Hidden lines. A medium-weight line of evenly spaced short dashes represents an edge, the intersection of two surfaces, or the surface limit which is not visible from the viewing angle of the drawing.

Center lines. A thin (light) line composed of alternate long and short dashes of consistent length is called a center line. It is used to signify the center of a circle or arc and to divide object into equal or symmetrical parts.

Dimension lines. A solid continuous line terminating in arrrowheads at each end. Dimension lines are broken only to permit writing in dimension. On construction drawings the dimension lines are unbroken. The points of the arrowheads touch the extension lines which mark the limits of the dimension. The dimension is expressed in feet and inches on architectural drawings and in feet and decimal fractions of a foot on engineering drawings.

NAME	CONVENTION	EXAMPLE
VISIBLE LINES		
HIDDEN LINES		
CENTER LINES		
DIMENSION LINES		

Extension lines. Extension line is a thin (light) unbroken line that is used to indicate the extent of the dimension lines. The extension line extends the visible lines of an object when it is not convenient to draw a dimension line directly between the visible lines. There is always a small space between the extension line and the visible line.

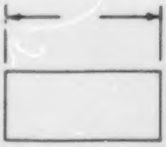
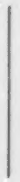
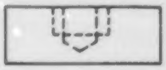
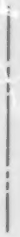
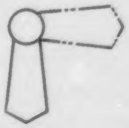
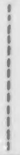
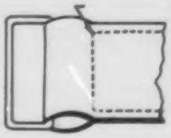
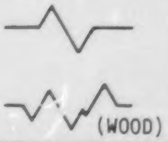
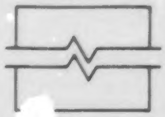
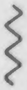
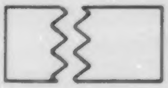
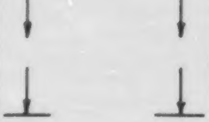
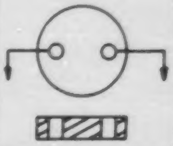
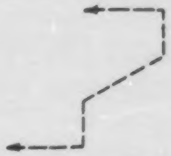
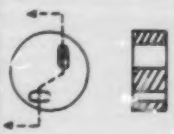
Leaders. A leader is a thin (light) line terminated with an arrowhead that is used to indicate the part or feature to which a number, note or other information refers.

Phantom lines or Datum Lines. A mediumweight line made of long dashes broken by two short dashes is called a phantom line and indicates one of three things: the relative position of an absent part, an alternative position of a part, or repeated detail which is not drawn.

Stitch lines. A medium line made of short dashes evenly spaced and labeled used to indicate stitching or sewing.

Break lines. A thin (light) line interrupted by a z-shaped symbol. The break line indicates that the object has been shortened to save space on the drawing. The true length is indicated by the dimension specified. The short break line convention varies with shape and material, as shown in figure 1-3. It indicates that part of the object has been cut away to show section detail or hidden features.

Cutting plane lines. A pair of short, heavy lines with arrowheads projected at 90° indicates the cutting plane when a drawing includes a section view. Letters (AA, BB, etc.) are usually placed at the arrowheads to identify the section view. The arrowheads show the viewing direction of the section view. Where necessary, the section lines may be connected by a line of short, heavy dashes indicating the exact path of the cutting plane.

NAME	CONVENTION	EXAMPLE
EXTENSION LINES		
LEADER		
PHANTOM OR DATUM LINE		
STITCH LINE		
BREAK (LONG)		
BREAK (SHORT)		
CUTTING OR VIEWING PLANE VIEWING PLANE OPTIONAL		
CUTTING PLANE FOR COMPLEX OR OFFSET VIEWS		

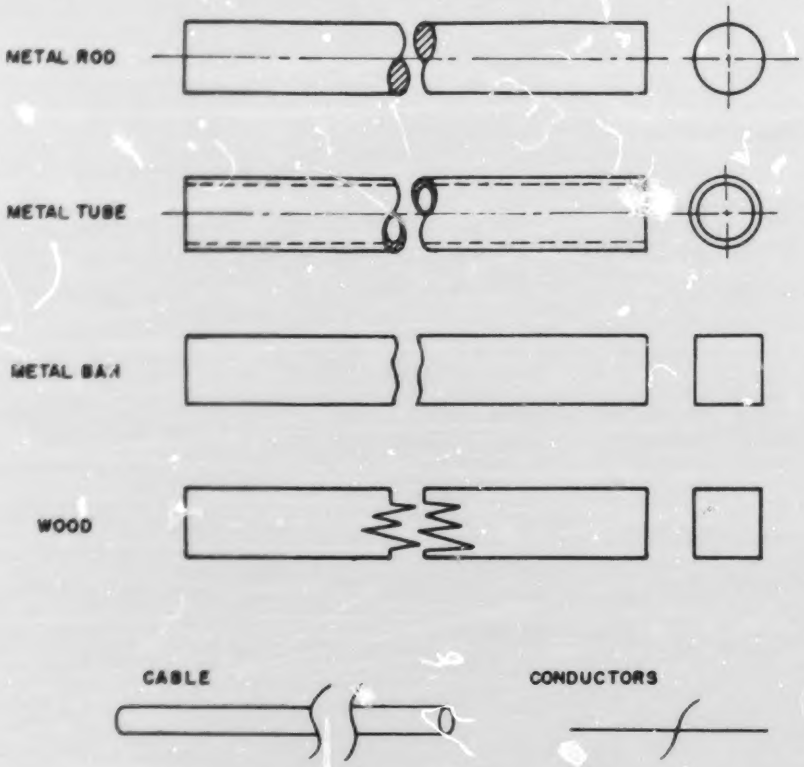
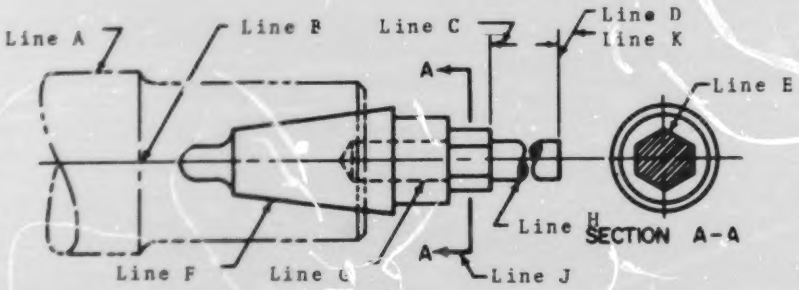

METAL ROD
METAL TUBE
METAL BAR
WOOD
CABLE
CONDUCTORS

Fig 1-3. Short break conventions.

EXERCISE: Answer the following questions about the illustration below and check your responses against those listed at the end of this study unit.


Line A
Line B
Line C
Line D
Line K
Line E
A
A
Line H
SECTION A-A
Line F
Line G
Line J

1. Which line convention is located at line A?

   a. Break
   b. Visible
   c. Center
   d. Phantom

2. Which line convention is located at line H?

   a. Break
   b. Hidden
   c. Extension
   d. Leader

3. Which line convention is located at line F?

a. Section
b. Visible
c. Dimension
d. Break

4. Which line convention is located at line G?

a. Center
b. Cutting
c. Hidden
d. Leader

5. Which line convention is located at line C?

a. Dimension
b. Extension
c. Visible
d. Break

Work Unit 1-2. PROJECTIONS AND DRAWINGS

IDENTIFY, FROM AN ILLUSTRATION, AN ORTHOGRAPHIC PROJECTION.

IDENTIFY, FROM AN ILLUSTRATION, AN ISOMETRIC DRAWING.

IDENTIFY, FROM AN ILLUSTRATION, AN OBLIQUE DRAWING.

When learning to read a construction print, you must develop the ability to visualize the object (fig 1-4). This is done by learning to properly interpret the various types of lines, dimensions, sections, details, symbols, and other media that are used to describe the object or parts of an object on a construction print.

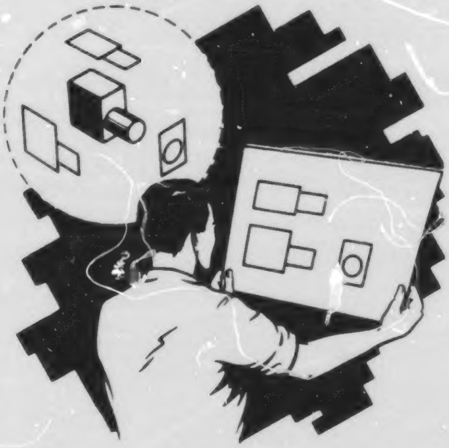
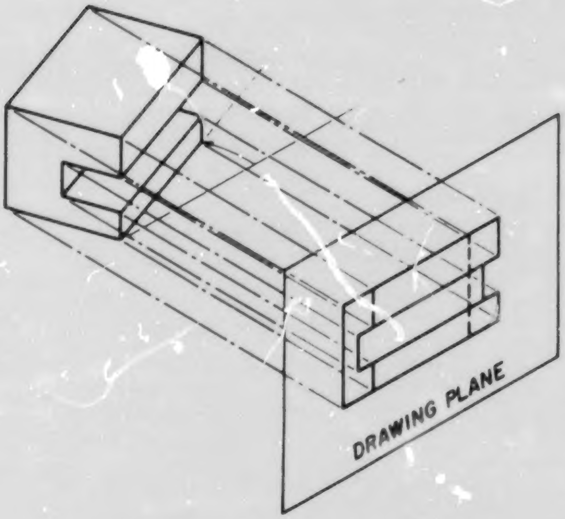
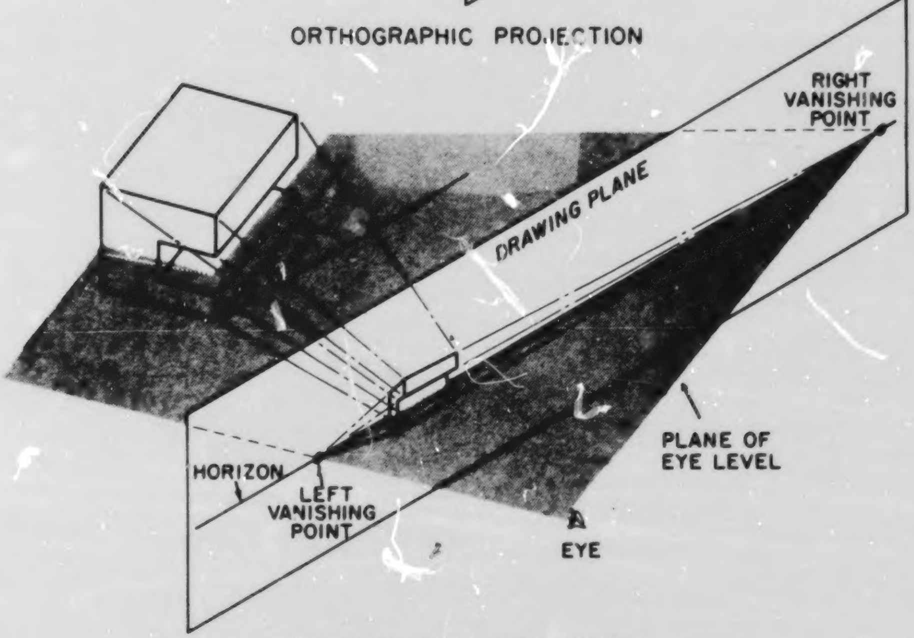


Fig 1-4. Visualizing from a print.

An object can be viewed and therefore drawn from an infinite number of positions. Some views are easier to draw and interpret than others. It is common to present an object on a drawing as an orthograhic projection or as a pictorial drawing. In an orthographic projection, the object is presented as if it were viewed through a transparent drawing plane from an infinite distance (fig 1-5). An orthographic projection is made by projecting each point on the object perpendicular to the drawing plane. A pictorial drawing, such as the perspective projection in figure 1-5, presents the object as it would appear to the eye.


DRAWING PLANE

ORTHOGRAPHIC PROJECTION


RIGHT VANISHING POINT
DRAWING PLANE
PLANE OF EYE LEVEL
HORIZON
LEFT VANISHING POINT
EYE

PERSPECTIVE PROJECTION

Fig 1-[illegible]. Orthographic versus perspective projection.

Orthographic projection. Almost all drawings as guides intended for production or construction are drawn by orthographic projection.

The major advantage of an orthographic projection is that it shows every part of an object that is parallel to the drawing plane in true relative size and position.

The number of views to be used in projecting a drawing is governed by the complexity of the shape of the drawing. Complex objects are normally drawn showing six views; that is, both ends, front, top, rear, and bottom. Figure 1-6 shows an object placed in a transparent box. The projections of the object on the sides of the box are the views seen by looking straight at the object through each side. If the outlines are scribed on each surface and the box opened and laid flat, the result is a six-view, orthographic projection drawing. It should be noted that the rear view may appear in any one of four positions (to the right of the right side view, to the left of the left side view, above the top view, or below the bottom view).

As a general rule, you will find that most drawings will be presented in three views. For a simple object, three views are adequate to completely describe the object when dimensions are added (fig 1-7). Occasionally, you will see two-view drawings, particularly cylindrical objects. The most common three-view drawing arrangement shows the front, top and right side view of an object.

In a three-view drawing, the front view shows the most characteristic feature of the object. Note in figure 1-7 that the right side or end view is projected to the right of the front. Also notice that all the horizontal outlines of the front view are extended horizontally to make up the side view and all the vertical outlines of the front view are extended vertically to make up the top view. By studying the drawing you should obtain the following information about the object: the shape of the object, its overall length (2 1/8 inches), its width (1 1/2 inches), and its height (1 3/8 inches). It is notched 1 1/8 inches from the right side and 7/8 inch from the bottom. After having studied each view of the object, you should be able to visualize the object as it appears in figure 1-8. If a hole is drilled in the notched portion of the object, the drawing would appear as in figure 1-9. The position of the hole is indicated by hidden lines in the front and side views and as a circle in the top view. The location of the center of the drilled hole is indicated by a center line.

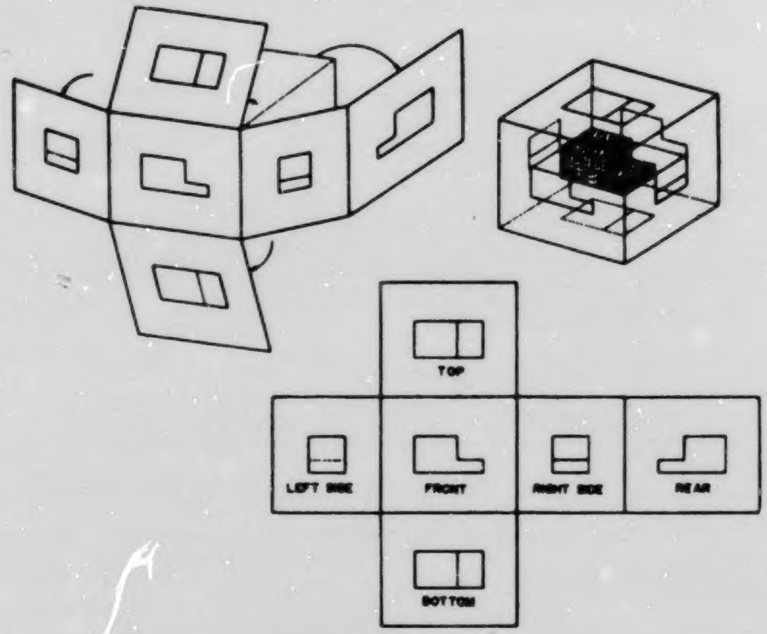

TOP
LEFT SIDE
FRONT
RIGHT SIDE
REAR
BOTTOM

Fig 1-6. Third angle orthographic projection.

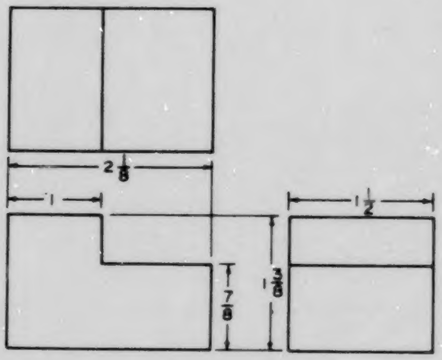

2 1/8
1
1 1/2
7/8
1 3/8

Fig 1-7. Three-view drawing.

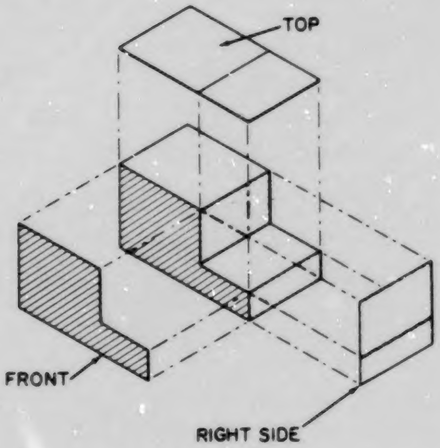


Fig 1-8. Interpretation of a three-view drawing.

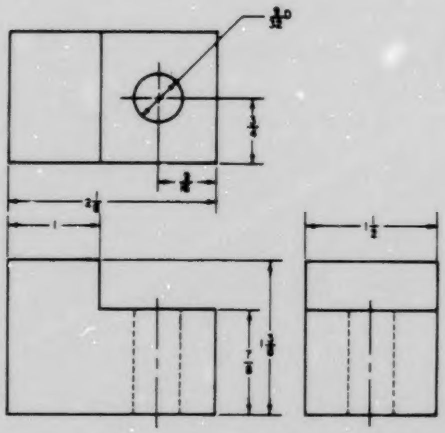


Fig 1-9. Hidden lines in a three-view drawing.

Isometric drawings. The isometric drawing is an easy drawing to be used by the beginner who wants to make a three dimensional effect. In an isometric drawing, all lines that are parallel on the object are also parallel on the drawing. Vertical lines are shown in a vertical position, but the lines representing horizontal lines are drawn at an angle of 30° with the horizontal. Also, on an isometric drawing, all the lines which represent the horizontal and vertical lines on an object have true length. Since all isometric lines are spread equally (120°), the same scale of measure is used on the three visible sides. Isometric drawings (fig 1-10) may be dimensioned, and blueprints of these drawings may be used for making simple objects. However, isometric drawings alone cannot be used for complicated parts or structures. Isometric drawings may be used as an aid in clarifying the orthographic drawings that are the foundation of all construction prints.

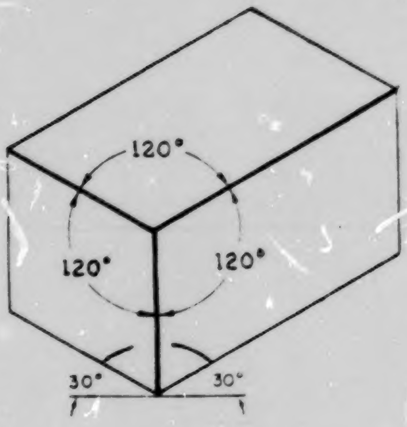
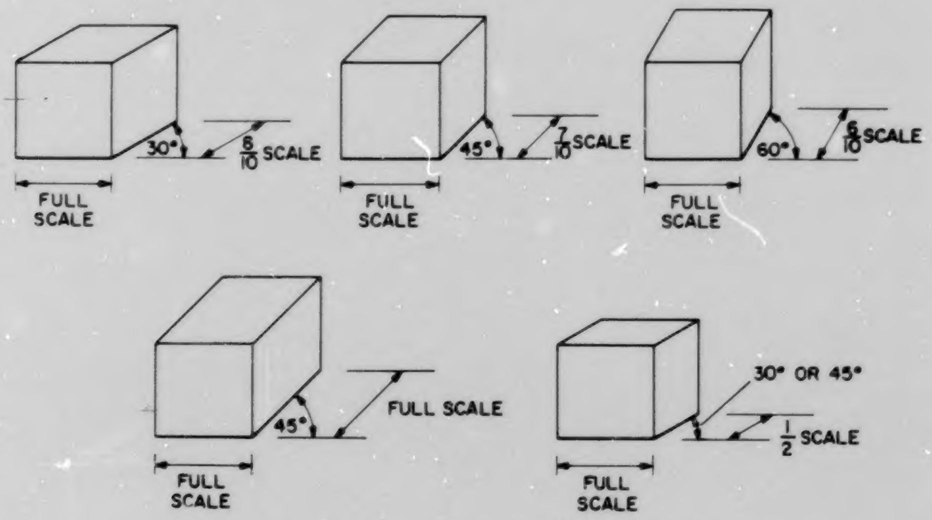

120°
120°
120°
30°
30°

Fig 1-10. Isometric drawing.

Oblique drawings. In oblique drawings, (fig 1-11), the front face of the object is drawn in orthographic form, full scale. One or more sides are then added at an angle to the front face, either full scale, or foreshortened. Any angle and scale may be used.

An oblique drawing in which the receding or oblique lines are drawn full-scale at 45° is called a cavalier drawing (fig 1-11). The result does not create a realistic appearance, but allows the use of one scale for the entire drawing.

A cabinet drawing is an oblique drawing which uses half-scale measurements on the oblique sides (fig 1-11). These drawings are commonly drawn with the oblique lines at 30° or 45° to the front plane. The name came into being because most often these drawings were of cabinet work.


30°
8/10 SCALE
FULL SCALE
45°
7/10 SCALE
FULL SCALE
60°
6/10 SCALE
FULL SCALE
45°
FULL SCALE
FULL SCALE
30° OR 45°
1/2 SCALE
FULL SCALE

CAVALIER DRAWING

CABINET DRAWING

Fig 1-11. Oblique drawings of a cube.

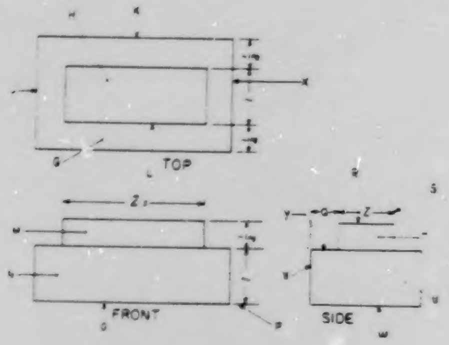
EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. As a general rule, most orthographic drawings will be presented in ________________ views.

   a. three
   b. four
   c. five
   d. six

2. The illustration below is an example of a three view

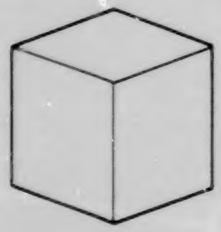
   a. isometric drawing.
   b. orthographic projection.
   c. trimetric view.
   d. auxiliary projection.



3. On an isometric drawing, all lines are drawn to true scale and the horizontal lines are drawn at an angle of ________________ to the horizontal.

   a. 60°
   b. 45°
   c. 30°
   d. 15°

4. The illustration below is an example of a(an) ______________________________.

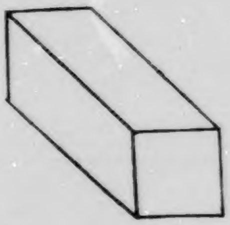


   a. orthographic view.
   b. cabinet drawing.
   c. dimetric view.
   d. isometric drawing.

5. When the sides are added to the front face of an oblique drawing, they may be at any angle and at

   a. only 8/10 scale.
   b. only 6/10 scale.
   c. only 4/10 scale.
   d. any scale.

6. The illustration below is an example of a(an)



a. oblique drawing.
b. perspective view.
c. rotation drawing.
d. section view.

Work Unit 1-3. SPECIAL VIEWS

IDENTIFY, FROM AN ILLUSTRATION, AN AUXILIARY VIEW.

IDENTIFY, FROM AN ILLUSTRATION, A ROTATION VIEW.

IDENTIFY, FROM AN ILLUSTRATION, A SECTION VIEW.

IDENTIFY, FROM AN ILLUSTRATION, A PHANTOM VIEW.

When complex objects are involved, three-view drawings are often not sufficient to convey all the necessary details. Special views are added to provide additional information. The special views which may be encountered are auxiliary, rotation section, phantom views, developments, and exploded views.

Auxiliary views. If a feature of an object is in a plane which is not parallel to one of the drawing planes, it will not appear in true size or shape in any of the three normal views. The sloping surface of the object in figure 1-12, for example, appears in both the top and right side views but is foreshortened in both. In this case, an auxiliary projection is added. The auxiliary view is obtained by projecting lines to a drawing plane which is parallel to the slanted face. The auxiliary view is normally placed alongside a view which shows the true length of the edge of the slanted surface as shown in figure 1-13. In this case, the auxiliary view is related to the front view in the same way as the top or right side view is related to the front view. If the feature to be covered in an auxiliary view is not in a plane perpendicular to one of the normal orthographic drawing planes, or if there is not enough room in the normal position, the auxiliary view will be placed somewhere else on the drawing. In this case, the auxiliary view will usually be labeled as "view A" (or B, C, etc.) with an arrow pointing to the face. Auxiliary views do not usually show the entire object as seen from the auxiliary view angle; only the surface parallel to the auxiliary drawing plane is covered. Figure 1-14 shows an auxiliary view compared with a right side view of the same object. Note that the circles appear as ellipses in the right side view, with the distance between centers foreshortened. The auxiliary view only shows the slanted face of the object, the holes appear in true shape, and the distance in true length.

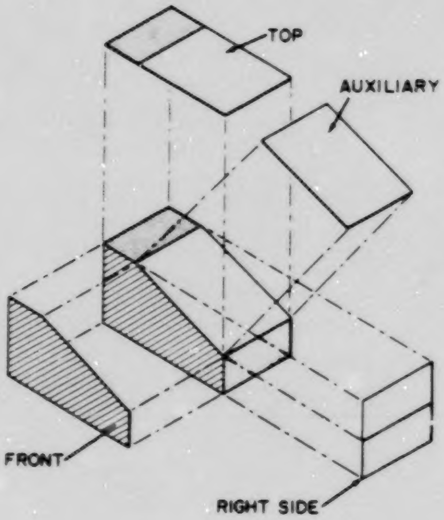

TOP
AUXILIARY
FRONT
RIGHT SIDE

Fig 1-12. Auxiliary projection principle.

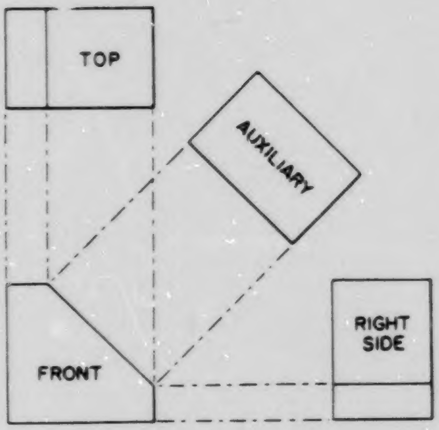

TOP
AUXILIARY
FRONT
RIGHT
SIDE

Fig 1-13. Auxiliary view arrangement.

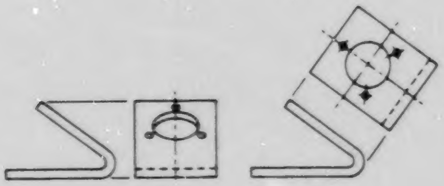


Fig 1-14. Auxiliary and side views compared.

Rotation. Occasionally, if no confusion will result from the practice, a separate auxiliary view is omitted and a side or top view is provided. This is drawn as if the object were bent to bring the slanted surface parallel to the drawing plane (fig 1-15). This is called a rotation, and the fact that it has been done will be indicated in some manner on the drawing. In figure 1-15, for example, the fact that one view is higher than the other, plus the curvature of the upper center line shows immediately that the right hand view is a rotation.

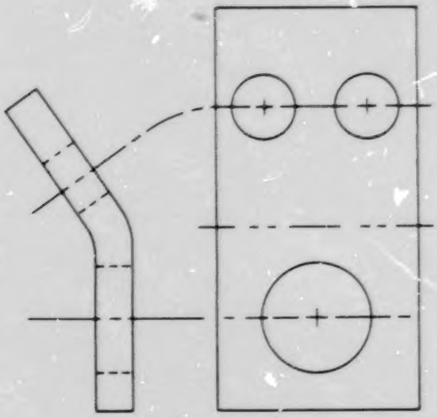


Fig 1-15. Rotation.

Sections. Section views are used to give a clear view of the interior or hidden features of the object which normally cannot be clearly observed from conventional outside views. A section view is obtained by cutting away part of an object to show the shape and construction at the cutting plane. The most common position of the cutting plane is through the longest dimension, or main longitudinal axis and parallel to the front view as shown in figure 1-16. The cutting plane may be drawn parallel to any plane of projection if it shows the required features of the object. When section views are drawn, the part that is cut by the cutting plane is marked with closely spaced, parallel (section) lines. The section lines indicate the surfaces which were created by the cutting plane and which do not exist on the uncut object. When two or more parts are cut in one view, a different slant or style of section line is used for each part. All rules of projection apply, but hidden lines complete the understanding of the view. Notice how the cutting plane is shown on a drawing as illustrated in 1 of figure 1-16. The cutting plane in 2 illustrates where the imaginary cut is made. The object as it would look if it were cut in half is shown in 3. The section view as it would appear on a drawing is shown in 4.

Full-sections. When the cutting plane is a single continuous plane passing entirely through the object, the resulting view is called a full-section, view 1 (fig. 1-17). The cutting plane is usually made straight through on the main axis or center line.

Half-sections. The cutting plane will not always be made completely through the object. You will notice that 2, figure 1-17 shows a half-section. The cutting plane passes only halfway through the object. This is common practice for symmetrical objects. In the case illustrated, the top half, if sectioned, would be identical to the bottom half, providing no additional information. The half-section permits both the internal and external features to be shown as well as their relationship to one another.

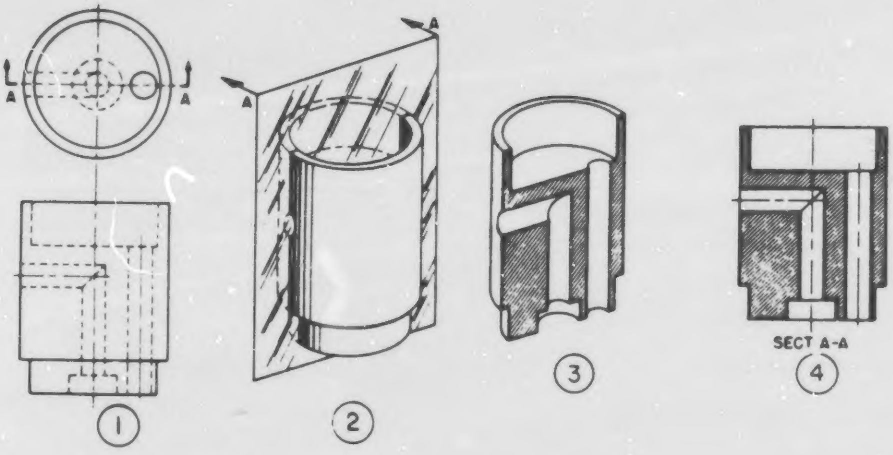
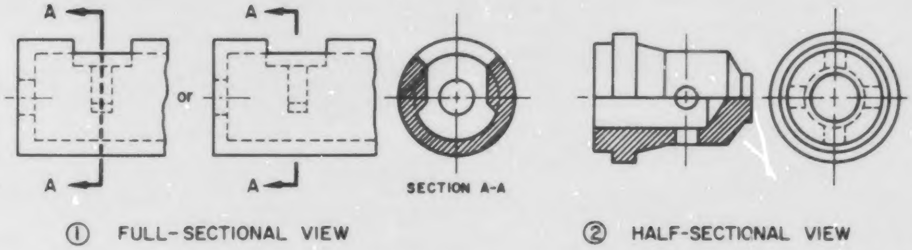

A
A
A
A
SECT A-A
1
2
3
4

Fig 1-16. Action of the cutting plane.


A
A
or
A
A
SECTION A-A

① FULL-SECTIONAL VIEW ② HALF-SECTIONAL VIEW

Fig 1-17. Full and half-sectional views.

Offset section. A section view with a cutting plane that changes direction backward and forward (zig-zag), to show important features, is known as an offset section. The offset cutting plane in figure 1-18 is arranged to show the hole on the right side, in section. The sectional view is the front view, and the top views show the offset cutting plane line. Notice that there is no line on the section view at the point where the cutting plane goes straight back.

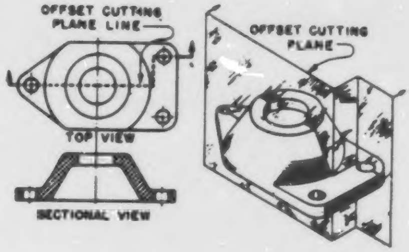

OFFSET CUTTING PLANE LINE
OFFSET CUTTING PLANE
TOP VIEW
SECTIONAL VIEW

Fig 1-18. Offset section.

Revolved section. To eliminate drawing extra views of rolled shapes, ribs, and similar forms, a revolved section is used. It is a drawing within a drawing, and it clearly describes the object's shape at a certain cross-section station or point. The sectional view of the rib in figure 1-19 has been revolved so that you can look at it head-on.

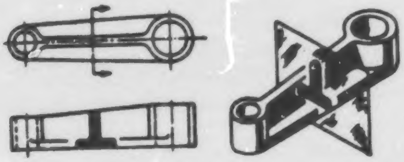


Fig 1-19. Revolved section.

Removed section. Removed sections are normally used to illustrate particular parts of an object (fig 1-20). They are drawn like the revolved section, except that they are placed at one side to bring out important details. They are often drawn to a larger scale than the one used on the view where they are illustrated.

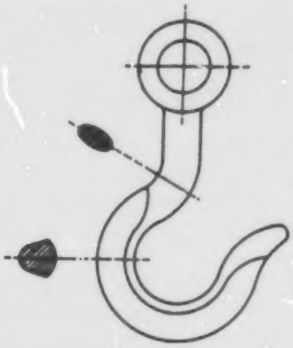


Fig 1-20. Removed section.

Broken-out section. A broken-out section is a partial section used on an exterior view to show the interior detail without drawing a complete full or half section. The limit of the broken-out section is indicated with an irregular break line. In figure 1-21, the inside of the fitting is better illustrated because of the broken-out section.

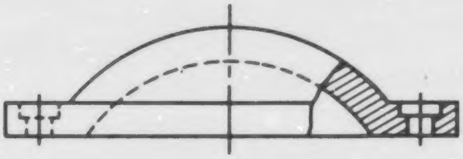


Fig 1-21. Broken-out section.

Alined section. Look at the front view of the handwheel in figure 1-22 and notice the cutting plane line AA. When a true sectional view might be misleading, parts such as ribs or spokes are drawn as if they are rotated into or out of the cutting plane. Notice that the spokes in the section at A-A are not sectioned. In some cases, though not in this figure, if the spokes were sectioned, the first impression would be that the wheel had a solid web rather than spokes.

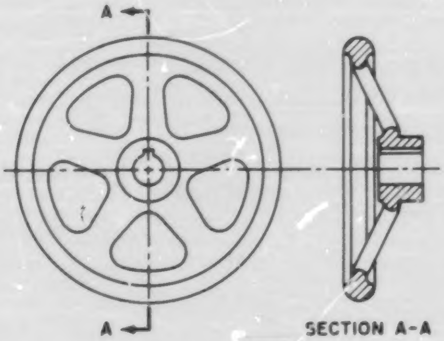


Fig 1-22. Alined section.

Phantom views. Phantom views are used to indicate the alternate position and path of motion of parts, repeated details, or the relative position of an absent part. Figure 1-23 shows the alternate position of a part as a phantom view (the part on the left side).

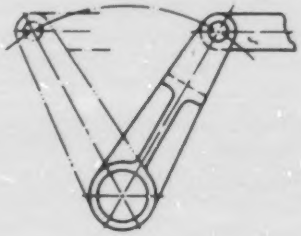


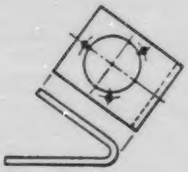
Fig 1-23. Phantom view.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. A drawing that is obtained by projecting lines to a drawing plane which is parallel to the slanted face is known as a(an)

   a. alined section.
   b. phantom view.
   c. removed section.
   d. auxiliary view.

2. The illustration below is an example of a(an)

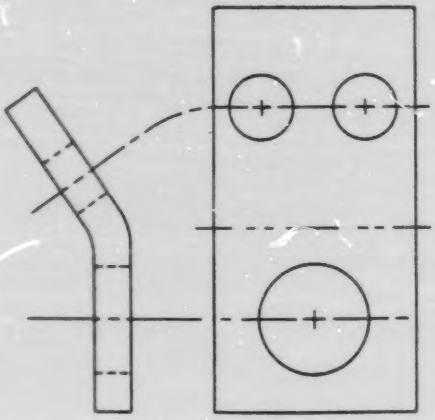


a. section view.
b. broken-out section.
c. phantom view.
d. auxiliary view.

3. A drawing that is drawn as if the object were bent to bring the slanted surface parallel to the drawing plane is called a(an)

a. rotation view.
b. offset section.
c. alined view.
d. removed section.

4. The illustration below is an example of a(an)



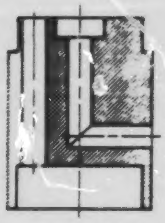
a. exploded view.
b. offset section.
c. phantom cut.
d. rotation view.

5. Which view is obtained by cutting away part of an object to show the shape and construction at the cutting plane?

a. Auxiliary
b. Rotation
c. Phantom
d. Section

30

6. The illustration below is an example of a(an)

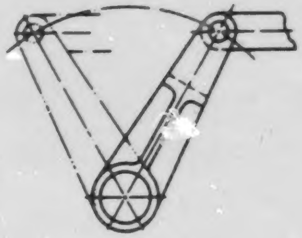


a. section view.
b. phantom view.
c. rotation view.
d. auxiliary view.

7. Which view is used to indicate the alternate position and path of motion parts?

a. Auxiliary
b. Rotation
c. Phantom
d. Section

8. The illustration below is an example of a(an)



a. auxiliary projection.
b. phantom view.
c. alined section.
d. development view.

Work Unit 1-4. TYPES OF PRINTS

NAME THE THREE TYPES OF PRINTS.

Drawings are normally classified as original drawings, intermediate or reproducibles, and prints. The original drawing is the one produced by the draftsman. An intermediate one is a copy of the original which is used to make prints. An intermediate drawing is used to avoid the risk of damaging the original or because the original is not suitable for the type of reproduction process used to make prints. However, prints may also be made directly from the original without using an intermediate drawing. A print is a working copy used on the job.

Many processes are used to make prints from originals or intermediates. They can be classified as either negative or positive contact processes or optical processes. Contact processes require a transparent or translucent original. Optical copies can be made from opaque originals. Contact processes are normally used in construction work. Optical copies are usually more expensive and introduce more distortion.

Negative Contact Processes.

Blueprints. A blueprint is made by placing a tracing (transparent or translucent original) in contact with a sensitized paper and exposing the paper through the tracing. When the paper is developed, the unexposed portions where the light is blocked by lines on the original remain white, while the exposed portions turn dark blue. This produces a print with white lines on a blue background. Blueprints, in general, have better contrast than other commonly used processes of comparable cost, but the wet developing process causes some distortion, and marking the prints is difficult.

Brownprints. The brownprint process (often called Van Dyke) is similar to the blueprint process except that the paper is transparent and exposed areas turn brown when developed. This yields transparent lines on a brown background. Brownprints are frequently used as intermediate copy which will produce a print that has blue lines on a white background and it is called a white print.

Positive Contact Processes.

Ozalid prints. The ozalid process is a contact process like blueprinting but the unexposed areas of the sensitized paper turn blue when developed in ammonia vapor producing blue lines on a white background. Ozalid prints are also called blueline prints. Also available is paper which yields black lines (called blackline prints). The development in this process is dry and causes less distortion than the blueprint process, but the contrast usually is not as good.

> Note: There are machines available which produce ozalid-process prints but which project and reduce the image optically instead of by contact-printing. Prints produced by this process will usually be marked "Reduced Size Print-Do Not Scale."

Brownline prints. Brownline prints have the same function in the ozalid process as the brownprints have in the blueprint process. They produce brown lines on a transparent background and are often used as an intermediate for making blueline prints. Brownline prints are often called sepia intermediates.

Special materials. There are materials available for use with the ozalid process which produce a large variety of results, including many colored lines on white paper or colored lines on a clear plastic background.

Optical Processes.

Electrostatic. An electrostatic copier (Xerox machine for example) projects an image of the original on paper and then causes an electrostatic charge to be deposited where the image of a line occurs. A black powdered "ink" is then applied to the paper and adheres where the electrostatic charge occurs. The image is then fused to the paper. This process produces a dark gray image on a white background. The amount of distortion depends on the type and quality of the optical system which projects the image on the copy paper.

Photostat. The photostat process is a photographic process which uses a special camera and film. The film is opaque paper instead of transparent film as in ordinary photography. Since the negative is opaque and cannot be viewed from the back, the camera is designed to produce an erect image instead of a reversed image as with ordinary cameras. The photostat process produces white lines on a black background (negative photostat) which can then be rephotographed to produce a black image on a white background (positive photostat). The image can be enlarged or reduced in the photostat process, usually to 1/2 or 2 times original size in each stage.

Microfilm. For economy of storage space and for insurance against destruction of the original, many drawings are photographically copied on microfilm. When a drawing is no longer in frequent use, the original is often disposed of and only the microfilm copy is retained. Equipment is available for viewing microfilm copies (similar to a slide viewer) and for making prints directly from microfilm copies. Since the image must go through the original optical reduction, developing of the microfilm, enlargement, and the final print process, the chance of producing a distorted copy is high.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. Which process is used to make blueprints and brownprints?____________________
2. What process is used to make brown line and ozalid prints?

____

3. What process is used to make electrostatic, photostat, and microfilm prints?

____

4. What are the three processes used to make prints from originals or intermediates?

a. ____

b. ____

c. ____

Work Unit 1-5. HANDLING PRINTS

DESCRIBE THE CORRECT WAY TO FOLD A PRINT.

A completed drawing represents too much time and effort to be treated casually. It is a valuable record; hence it must be preserved with care. If an original drawing were to be used on the job and passed from man to man, it would soon become worn and too dirty to be read. For this reason, working drawings used on the job are almost always reproductions of original drawings.

A little time spent in carefully folding and filing prints at the start will prevent a lot of inconvenience later on. The method of folding depends on the facilities available for storage. Some filing equipment commonly used is shown in figure 1-24. When manufactured filing equipment is not available in the field, storage facilities should be constructed. Prints should be folded so the drawing number is visible when the print is filed. If storage space is available to accommodate rolls, prints over 40 inches long are usually rolled instead of folded. Original drawings or intermediates used for contact process reproduction should never be folded; the creases will prevent close contact with the copy paper.

When using prints on the job, avoid long exposure to direct sunlight or the prints will fade. If it is necessary to mark a print, be neat and use a colored pencil. A red pencil is normally used to show additions, and a yellow pencil is used to indicate deletions. After using a print, refold it carefully to avoid adding unnecessary creases.

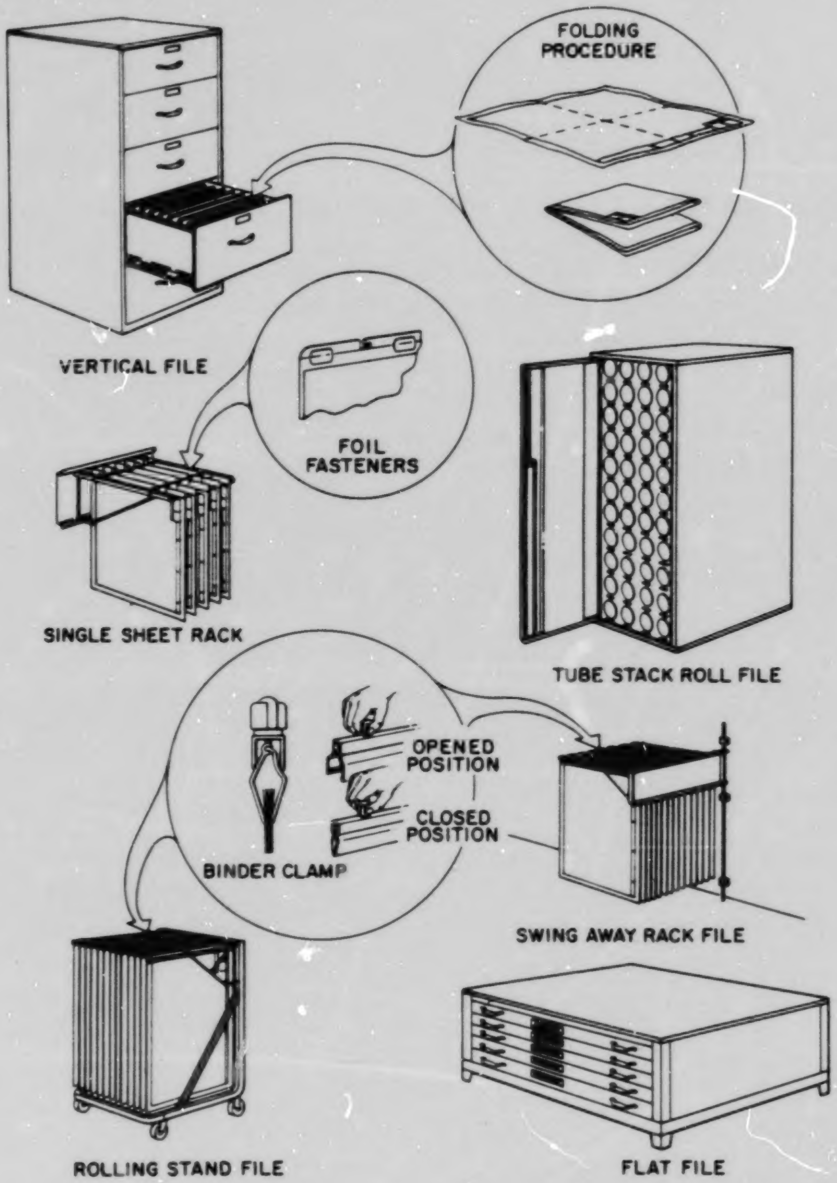

FOLDING PROCEDURE
VERTICAL FILE
FOIL FASTENERS
SINGLE SHEET RACK
TUBE STACK ROLL FILE
OPENED POSITION
CLOSED POSITION
BINDER CLAMP
SWING AWAY RACK FILE
ROLLING STAND FILE
FLAT FILE

Fig 1-24. Print and drawing storage.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. How are prints over 40 inches long stored or filed?

   ____

2. How are prints under 40 inches stored or filed?

   ____

3. When prints are filed, they should be folded so the ______________________

   ____

Work Unit 1-6. PARTS OF A PRINT

NAME THE FOUR PARTS THAT MAY BE FOUND ON A PRINT.

A drawing not only provides information about the size and shape of the object being represented but also provides information that enables the drawing to be identified, processed, and filed methodically. The systematic arrangement of the drawing sheet to provide a consistent location for this information is known as the format of a drawing. Sizes and formats for military drawings are arranged in accordance with certain standards.

Military drawings are prepared in standard sizes, designated by letters. These sizes are listed in table 1-1. Roll size drawings are normally prepared with an extra 4-inch margin for protection, if possible, without exceeding the 144-inch length limit. Complete details on military drawings may be found in MIL-STD-100A.

Table 1-1. Finished format sizes (inches)

SIZE	HEIGHT	LENGTH	MARGIN
	Flat Sizes		
A	8½	11	.25 & .38*
A	11	8½	.25 & .38*
B	11	17	.38
C	17	22	.50
D	22	34	.50
E	34	44	.50
F	28	40	.50
	Roll Sizes		
G	11	42 to 144	.38
H	28	48 to 144	.50
J	34	48 to 144	.50
K	40	48 to 144	.50

*Horizontal margins .38-inch vertical margins .25-inch

Title block. A typical title block as illustrated in figure 1-25, shows the name and address of the preparing agency (A), the title of the drawing (B), the drafting record (C), authentication and date (D), the scale and specification number (E), and the drawing number and sheet number for multiple-sheet drawings (F).

BEST COPY AVAILABLE

Each drawing is identified by a drawing number, which appears in a number block. It may be shown in other places also; for example, near the top border line, in the upper corner, or on the reverse side at both ends so that it will be visible when a drawing is rolled up. The purpose of numbering a drawing is to permit its identification quickly. If a drawing has more than one sheet and each sheet has the same number, this information is included in the number block indicating the sheet number and the number of sheets in the series. When using construction drawings, always check to be sure that all necessary sheets are on hand. Some multiple-sheet construction drawings have a "schedule of drawings" near the title block which lists the contents of each sheet.

The scale block will indicate the scale used on the drawing, either as a ratio (for example: 1/4 or 1:4 meaning 1 inch on the drawing equals 4 inches on the object, or 12" = 1" meaning 12 inches on the drawing equals 1 inch on the object) or as a graphic scale as shown in figure 1-26. If the same scale is not used on all parts of a drawing, the scale block may be marked "as noted" or left blank, and the scale noted underneath each part of the drawing. If graphic scales are used, several scales may be shown with numbers (fig 1-26) and the appropriate scale number noted alongside each part of the drawing. When you read drawings, always follow the dimensions specified on the drawing first, and use the scale on the drawing where dimensions are not given. Do not measure with an architect's or engineer's scale directly on a print, since the print may be enlarged or reduced or the paper may shrink during the copying process.

The specification number indicates the specification the draftsmen followed for assistance in interpreting the drawing.

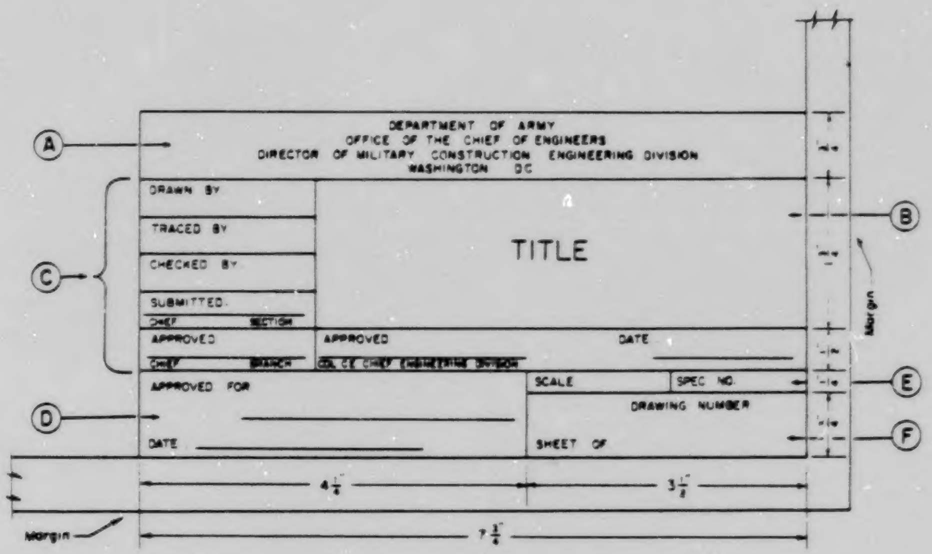

A
DEPARTMENT OF ARMY
OFFICE OF THE CHIEF OF ENGINEERS
DIRECTOR OF MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON DC
B
C
DRAWN BY
TRACED BY
CHECKED BY
SUBMITTED
CHIEF SECTION
APPROVED
CHIEF BRANCH
TITLE
APPROVED
COL CE CHIEF ENGINEERING DIVISION
DATE
Margin
D
APPROVED FOR
DATE
E
SCALE
SPEC NO.
DRAWING NUMBER
F
SHEET OF
4 1/4"
3 1/2"
7 3/4"
Margin

Fig 1-25. Typical title block.

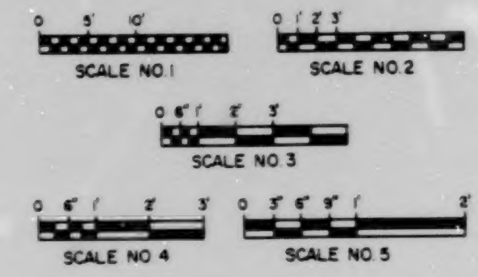


Fig 1-26. Graphic scales.

Bill of materials. A special block on the drawing may contain a list of the pieces of stock or standard parts necessary to construct the object on the drawing, and the quantity of each item required. This list may also be called a list of materials, schedule of equipment, or parts list. If several sheets are required for a particular object, the bill of materials may appear on a separate sheet(s).

Revision block. Space is always left on a drawing to list revisions as they are made. The revision block will show the revision symbol, A, B, C, etc. consecutively as encountered, a brief description of the revision, the revision date and supervisor's approval, and sometimes the zone on the drawing where the revision was made. If more than one copy of a drawing is available, the revision block should be checked to find the drawing with the latest revision.

Notes and specifications. Notations explaining construction methods or specifying materials which are not indicated by symbols are called specifications. The notes may list allowable substitutions, special provisions for certain locations, additional reference material, and so forth. The notes must always be read before beginning construction.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. In which part of a drawing will you find the title of the drawing, the drafting record, and the scale used?

   ____

2. What part of the drawing will list pieces of stock or standard parts necessary in the construction of an object?

   ____

3. Where will revisions be listed on a drawing?

   ____

4. Notations explaining construction methods or specifying materials which are not indicated by symbols will be found in the ______________________________.

5. Name the four parts that may be found in a print.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

Work Unit 1-7. MILITARY DRAWINGS

NAME THE TWO CLASSIFICATIONS OF MILITARY DRAWINGS.

Military drawings are classified as construction or production drawings depending on the method of manufacture of the object or assembly represented on the drawing or set of drawings. The format of each type is arranged differently, although sheet and margin sizes are common to both.

Construction drawings. Construction drawings are drawings developed to illustrate the design of structures or other constructions and the services, utilities, approaches, or any other features involved. Maps (except those with construction drawings), reports, sketches, presentation drawings, or renderings are not considered to be construction drawings within the meaning of this standard.

Production drawings. Production drawings describe equipment or articles that are suitable for production in quantity. The same basic information is normally included on a production drawing format as on a construction drawing format although the arrangement is different.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. Drawings developed to illustrate the design of structures or other constructions are known as ______________________________.

2. Drawings that describe equipment or articles that are suitable for quantity production are called ______________________________.

3. What are the two classifications of military drawings?

   a. ______________________________

   b. ______________________________

Work Unit 1-8. INTERPRETATION OF DRAWINGS

IDENTIFY THE SAME POINT OR LINE ON DIFFERENT VIEWS OF THE SAME OBJECT.

The objects used for illustrations thus far have been simple, and interpretation of the drawings nearly obvious. To interpret more complex or irregular drawings may require more effort. The principles introduced here, along with the conventions peculiar to certain fields which will be discussed in the following study units, will enable you to interpret any properly prepared drawing. The orthographic projection principles are fundamental to all fields, and a thorough understanding of these principles is necessary if you are to read any type of physical prints.

The fundamental step in interpreting a drawing is relating the different views. If you pick a point on a front view, the same point on the right side view will be directly to the right of it. Similarly, the same point on the top view will be directly above the point on the front view. These relationships are illustrated in 1 of figure 1-27, by the horizontal and vertical datum lines between the views. The same relationship exists between the top and right side views but is not obvious because they are not hinged together. If the outside edges of both views are extended horizontally or vertically until they cross, as in 2 of figure 1-27, and a line is drawn connecting these points of intersection, the relationship can be seen. The line connecting the points of intersection will be at a 45° angle with the horizontal. All other points in the views can be related by bending their project line at this 45° line. If the same point appears on three views, the three occurrences will be related as shown by point 1 in part 2 of figure 1-27. On complex drawings, it is often helpful to draw this 45° line to be sure you are looking at the same point on all three views when interpreting the drawing.

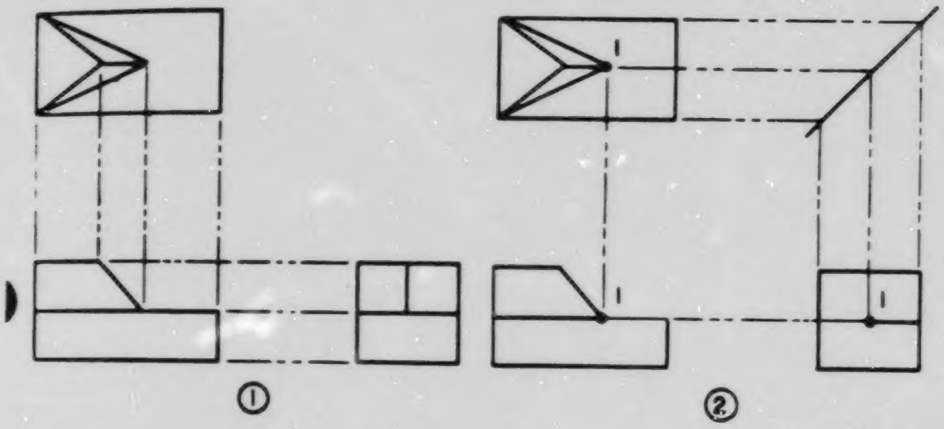


Fig 1-27. Relationships in orthographic projection.

Figure 1-28 is a three-view drawing of an object, along with an isometric outline of a box with the same overall dimensions of the object. Trace the isometric outline and points on a separate piece of paper and sketch in the details as you read the paragraph. This will help you learn to visualize the object as you interpret a construction print. Looking at the right hand side of the front view, and the corresponding parts of the top and side views, interpretation of the part of the isometric diagram that has been completed should be apparent. Note the point marked "a" on the top view. From the projection indicated it must be the same as the point marked "a" on the right side view. Projecting these two points to the front view, you will see that the point marked "a" on all three views is the same point and it is located at "a" on the isometric diagram. Next, look at the line "a h" on the front view. Point "h" on the front view may correspond to point "g" or point "f" on the top view, but there is no line from "a" to "f" on the top view. Line "a, h" therefore, must correspond to line "a g," and transferring points to the right side view to line "a e." On the isometric view, this corresponds to the line from "a" to "n," which can now be drawn on the isometric view. Line "a b" on the front view must correspond to line "a c" on the top view, and to line "a d" on the right side view. This translates as a line from "a" to "q" on the isometric view. At this stage, it is evident that line "e l" (right side view) is the same as line "h j" (front view), and a line has been drawn from "p" to "n" on the isometric view. Similarly, line "f c" (top) is the same as line "h b" (front), and a line has been drawn from "m" to "q" on the isometric view. Line "c g" (top) may correspond to either "h b" or "j a" (front), but not to "h a," which has already been established. If "c g" corresponds to "j a", it would also have to correspond to "l a" in the right side view, because point "a" has been established and "c g" does not project to "l a" in the right side view. Therefore, "c g" corresponds to "h b" in the front view and to "e d" in the right side view. Line "c g" must correspond to a line from "n" to "g" on the isometric view. All that remains is to complete the isometric view with the only possible lines which do not contradict one or more of the three views; lines from "p" to "a", from "a" to "r", and from "r" to "q" produce an isometric which should look like figure 1-29.

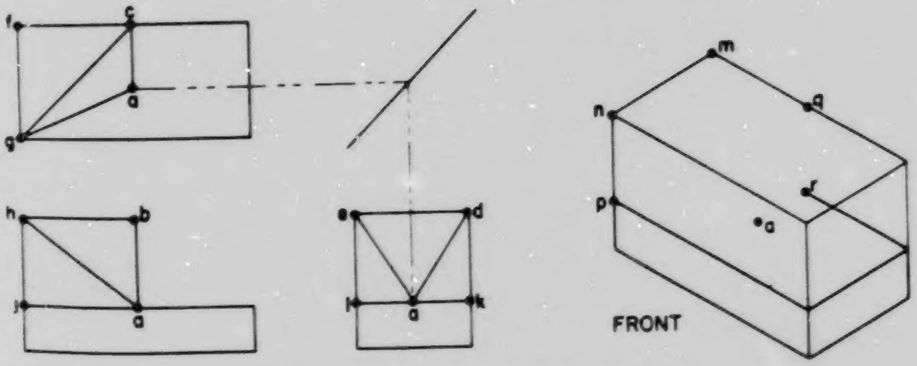

f
c
a
g
h
b
j
a
e
d
j
a
k
m
n
q
r
p
a
FRONT

Fig 1-28. Exercise in interpretation.

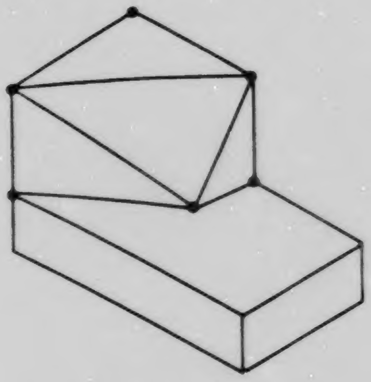
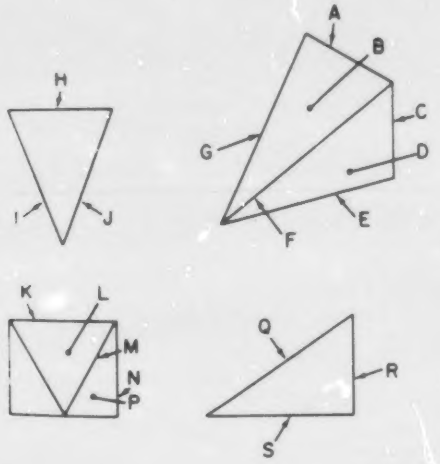


Fig 1-29. Completed exercise.

EXERCISE: Answer the following questions about the illustration below. Check your responses against those listed at the end of this study unit.



1. Which surface on the isometric drawing is represented by surface L on the front view?____________________

2. Which surface on the isometric drawing is represented by surface P on the front view?____________________

3. Which line on the isometric view is represented by line Q on the right side view?

____

4. Which line on the top view represents line F on the isometric view?

____

SUMMARY REVIEW

In the preceding work units you have been introduced to the principles and methods used in the interpretation of construction prints. You can now identify line conventions, projections, and special views. You can name the three types of prints used and the four parts that make them up. When asked, you can describe the correct way to fold a print so that the drawing number is visible. You can also name the two classifications of military drawings.

Answers to Study Unit #1 Exercises

Work Unit 1-1.

1. d. Phantom
2. a. Break
3. b. Visible
4. c. Hidden
5. a. Dimension

Work Unit 1-2.

1. a. three
2. b. orthographic projection.
3. c. 30°
4. d. isometric drawing
5. d. any scale
6. a. oblique drawing.

Work Unit 1-3.

1. d. auxiliary view.
2. d. auxiliary view.
3. a. rotation view.
4. d. rotation view.
5. d. Section
6. a. section view.
7. c. Phantom
8. b. phantom view

Work Unit 1-4.

1. Negative contact
2. Positive contact
3. Optical
4. a. Negative contact
   b. Positive contact
   c. Optical

Work Unit 1-5.

1. Usually rolled
2. Folded
3. drawing number is visible

Work Unit 1-6.

1. Title block
2. Bill of materials
3. Revisions block
4. notes and specifications.
5. a. Title block
   b. Bill of materials
   c. Revision block
   d. Notes and specifications

Work Unit 1-7.

1. construction drawings.
2. production drawings.
3. a. Construction
   b. Production

Work Unit 1-8.

1. B
2. D
3. F
4. J

STUDY UNIT 2

PLANS AND DRAWINGS

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL BE ABLE TO IDENTIFY SYMBOLS AND ABBREVIATIONS THAT ARE USED IN PLOT, FOUNDATION, FLOOR, AND ELEVATION PLANS AND DRAWINGS. YOU WILL ALSO BE ABLE TO READ PLOT PLANS, FLOOR PLANS, AND ELEVATION DRAWINGS.

Working drawings plus specifications are the principal sources of information for supervisors and technicians responsible for the actual work of contruction. The construction working drawing presents a complete graphic description of the structure to be erected, the construction site, the materials to be used, and the construction method to be followed. Most construction drawings consist of orthographic views. A set of working drawings includes both general and detail drawings. General drawings consist of plans and elevations, while detail drawings comprise sections and detail views.

Section I. PLOT PLAN

The plot plan will normally be shown on the first sheet of a set of construction prints. The plot plan shows, as necessary, the property lines and locations, contours and profiles, existing and new utilities, sewer and waterlines, building lines, location of structures to be constructed, existing structures, approaches, finished grades, and other pertinent data.

Work Unit 2-1. CONTOUR LINES

IDENTIFY, USING A PLOT PLAN, THE FINISH GRADE AT ANY POINT.

When used with a plot plan, elevation is the height of any point on the lot measured from a ground point. Do not confuse the term elevation on a plot plan with an elevation drawing. An elevation drawing means the side view of a building or structure. Elevations are normally given for the more prominent points on the plot plan. For example, sidewalks, driveways, or finished levels of a building. Elevation is usually measured in feet and decimal feet rather than in feet and inches. Most elevations are measured from a reference point used in that area. The most common reference points used are: Mean sea level, mean lake level, or a datum point which has been established by the local town, city, county or state.

Contour lines are lines drawn on a plot plan to indicate the elevation of the earth's surface. All points on a contour have the same elevation. They may be one, two, five, or ten feet apart. Each contour line has an assigned value (elevation) and lies at a definite interval above and below other contour lines. Contour lines are the most accurate method of showing elevations on a plot plan. To better illustrate this, the figure 2-1 represents an imaginary hill in the middle of the ocean, the shore line would be the base or zero contour, because it is at sea level (0' elevation).

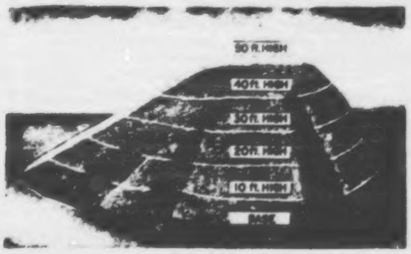


Fig 2-1. Side view of contour lines.

If the sea should rise 10 feet, it would leave a high-water mark like the 10-foot contour line. Similarly, the successive rises above zero elevation (sea level) would leave high-water marks or rings around the hill, like contour lines. Figure 2-2 gives an oblique view of the same hill. When viewed from directly above, the hill and the contour lines would appear as in figure 2-3. This is the viewpoint of a map or plot plan taken from directly above. When the picture of the hill is removed (fig 2-4), the hill is represented by contours alone.

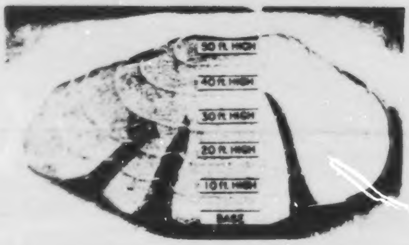

50 ft. HIGH
40 ft. HIGH
30 ft. HIGH
20 ft. HIGH
10 ft. HIGH
BASE

Fig 2-2. Oblique view of contour lines.

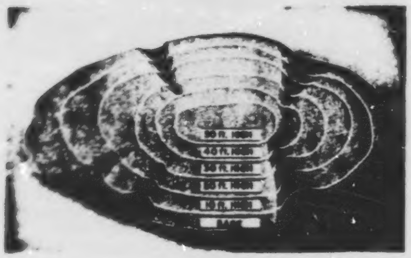

50 ft. HIGH
40 ft. HIGH
30 ft. HIGH
20 ft. HIGH
10 ft. HIGH
BASE

Fig 2-3. Top view of contour lines.

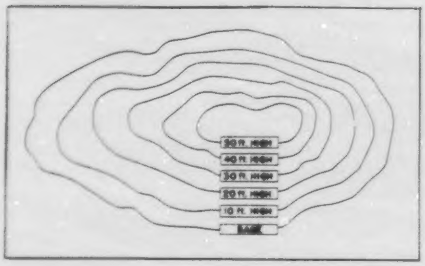

50 ft. HIGH
40 ft. HIGH
30 ft. HIGH
20 ft. HIGH
10 ft. HIGH
BASE

Fig 2-4. Hill shown on a map by contours.

Contour lines on a map are continuous and they always join together. A plot plan shows only a small part of an area; therefore the lines do not always join.

Figure 2-5, illustrates the relationship of contour lines. The contour interval in figure 2-5 is 50 feet; however, on plot plans the interval will normally be one foot. The smaller the contour interval, the more detailed the view on the plan. As the slope of the hill becomes steeper, the lines run closer together. The farther apart the lines are, the gentler the slope.

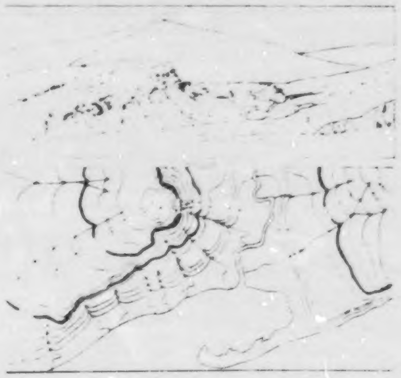
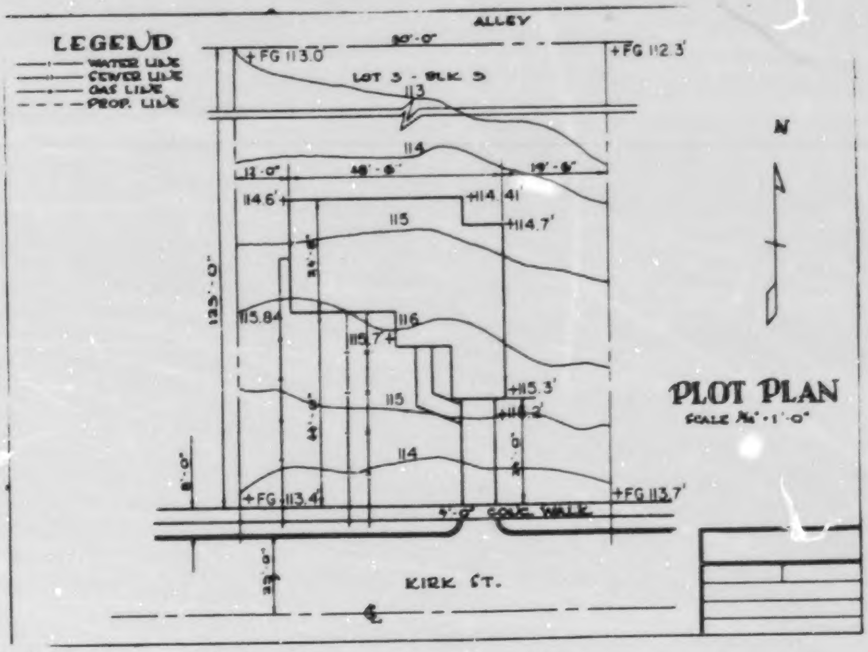


Fig 2-5. How contour lines help to analyze terrain.

Spot elevation. Points on a plot plan where the elevation is indicated by numbers is known as spot elevation. It is printed on or adjacent to an important feature. On a plot plan, this elevation number will be marked by a cross (+112, +126, etc).

Grade. The contour lines on a plot plan help the builder to visualize the slope of a lot. When the lot is not suited for building, the slope must be changed by moving earth from the high points to the low areas. When you do this, you change the natural grade (NG) to a finished grade (FG). The natural grade is usually shown by a dash line, and the finished grade normally will be shown by a solid line. Usually, the natural grade and the finished grade contour lines will appear on a plot plan if the grade has been altered.

EXERCISE: Answer the following items about the illustration below and check your answers against those at the end of the study unit.


ALLEY
LEGEND
WATER LINE
SEWER LINE
GAS LINE
PROP. LINE
50'-0"
+FG 113.0
+FG 112.3'
LOT 3 - BLK. 3
113
114
12'-0"
48'-6"
19'-6"
114.6'
114.41'
114.7'
115
125'-0"
115.84
116
115.7
115.3'
115
114.2'
114
8'-0"
+FG 113.4
+FG 113.7'
5'-0" CONC. WALK
KIRK ST.
N
PLOT PLAN
SCALE 3/64" = 1'-0"

1. The finished grade at the northwest corner of the house is __________ feet.

2. The finished grade at the southwest corner of the property is_________ feet.

3. What is the finished grade at the north end of the driveway?

____.

Work Unit 2-2. LOCATING FACILITIES

IDENTIFY, FROM A PLOT PLAN AND OBJECT OR FACILITY.

As stated at the beginning of this section, the plot plan will show, as needed, the property lines and locations, new and existing utilities, sewer and water lines, and building lines. Figure 2-6 shows a typical plot plan without the contour lines or spot elevations. The plan is oriented by a north pointing arrow to indicate site north (not magnetic north).

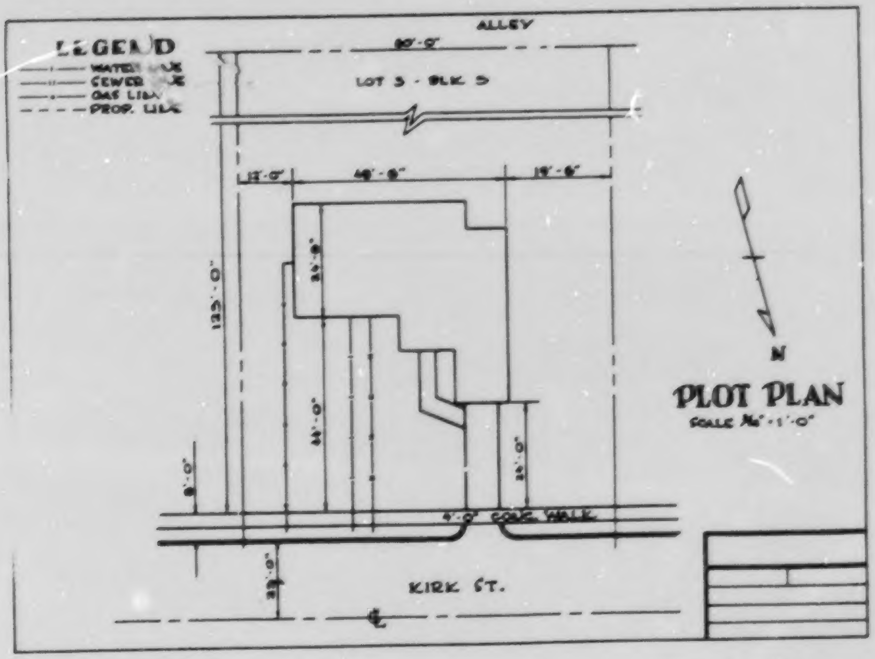


Fig.2-6. Typical plot plan.

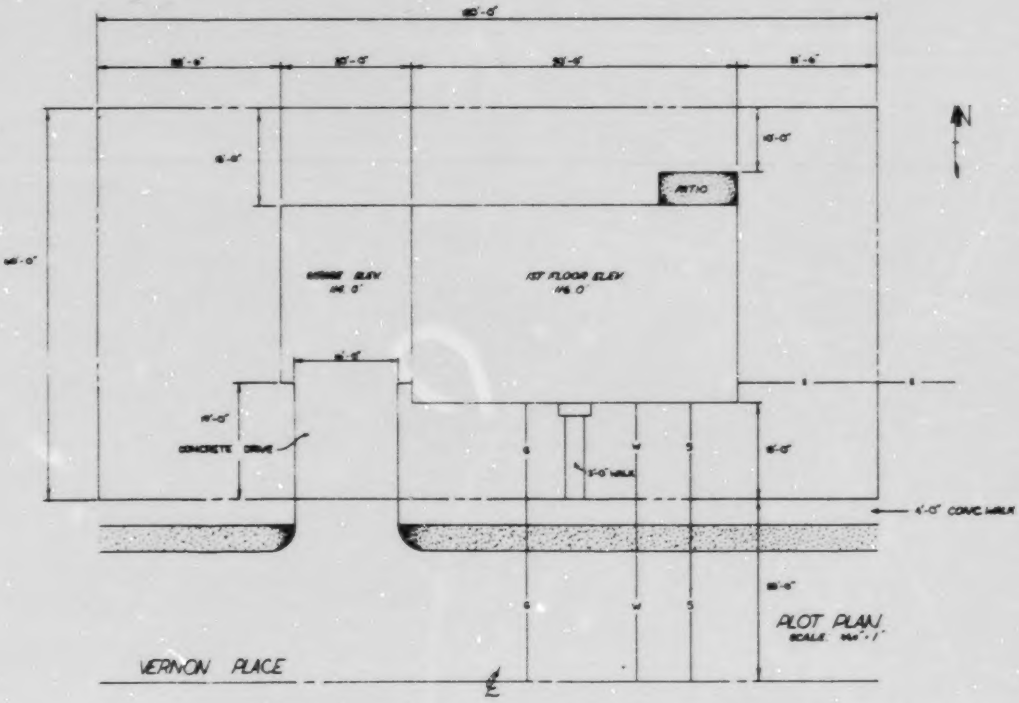
Property lines. Property lines or lot lines are normally shown by long lines separated by dashes or dots. The draftsman usually will indicate in the legend if something other than these marks are used. On some plot plans the corners will be given in degrees because some lots will have three, five, six, or more sides. Property lines and corners must be accurate so that the buildings can be correctly located within the site.

Location of buildings and facilities. Buildings or other facilities are located in relation to the property lines or to some other prominent feature such as a road. The distances between principal details and the property lines are furnished. All distances indicated in a plan view of the site express a horizontal measurement between two points and do not take into consideration terrain irregularities. The size of the proposed facility or building as well as the distance of the object from the property line is shown. In figure 2-6 one corner of the house is located 44 feet from the walk and the other corner is located 24 feet from the walk. The curb is 25 feet from the center line of the street, and there are 8 feet from the curb to the house side of the walk. You may need several dimensions to locate a building if the building is set at an odd angle to the property.

Sidewalks and roadways. Both existing and new approaches to the facilities will be shown on the plot plan. The position and sizes of the approach will normally be given. The existing roads and highways usually will be located by their centerlines. In figure 2-6 the walkway is 24 feet from the front of the building on the plan.

Location of existing and new utilities. The plot plan will show the location and the types of existing and new facilities. The symbols for utilities normally are dash-lines and a "W" for water, dash-line and "G" for gas, dash-line and "S" for sewer, and dash-line and "E" for electricity. However, not all architects use the same symbols; therefore, the architect will usually include these symbols in the legend. Figure 2-6 shows different utility symbols than those previously stated. However, the symbols used are the same as those shown in the legend: dash-line 1 for water, dash-line 11 for sewer, and dashed line 111 for gas. If there is any doubt about where the utilities are to be placed, the architect should be consulted.

EXERCISE: Answer the following items about the illustration below. Check your answers with those at the back of the study unit.



1. What is the distance between the garage and the west property line?

____

2. The patio is located how many feet from the north property line?__________

3. What is the distance between the house and the center line of Vernon Place?

____

4. What is the length of the north property line?__________

5. What is the width of the concrete walk leading to the house?__________

6. The street walk is located how many feet from the garage? __________

Section II. FOUNDATION PLAN

A foundation plan is a plan view of a structure projected on a horizontal plane which is achieved by looking down (in imagination, of course) from the top of the structure to be built to the foundations. The foundation plan will show the plan view. A foundation plan will normally give all the information needed to build the foundation of the structure. Foundations vary according to their intended use and the type of material to be used . The material may be cut stone, rock, brick, concrete, tile or wood, depending upon the weight which the foundation is expected to support. Foundations may be classified as wall or column (pier) foundations.

Work Unit 2-3. COLUMN FOUNDATIONS

IDENTIFY, FROM A FOUNDATION PLAN, A COLUMN FOUNDATION.

Footings. The footings are the base of the foundation and transmit the superimposed load to the soil. The type and size of footings should be suitable to the soil condition. In cold climates the footings should be implanted far enough below ground level to be protected from frost action. Local codes usually establish this depth, which usually is four feet or more in northern sections of the United States.

Poured concrete footings are more dependable than those of other materials and are recommended when used in house foundations. Where fill has been used, the foundation should extend below the fill into the undisturbed earth. In areas where adobe soil is prevalent or where soil moisture may cause shrinkage, the irregular settlement of the foundation and of the building it supports may occur.

Column footings. Footings for the columns (fig 2-7) should be square and should include a pedestal on which the member will bear. A protruding steel pin is ordinarily set in the pedestal to anchor a wood post. Bolts for the bottom plate of steel posts are usually set when the pedestal is poured. At other times, steel posts are set directly on the footing and the concrete floor is poured around them.

Footings vary in size depending on the allowable soil pressure and the spacing of the columns. Common sizes are 24 by 24 by 12 inches, and 30 by 30 by 12 inches. The pedestal is sometimes poured after the footing. The minimum height should be about 3 inches above the finished basement floor and 12 inches above finish grade in crawl-space areas.

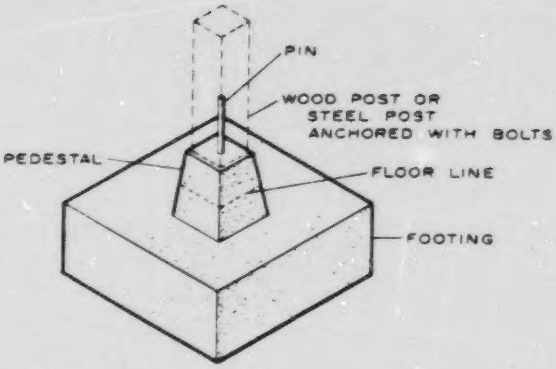


Fig 2-7. Column footing.

Column foundations. Column, post, or pier foundations save time and labor. They may be constructed of masonry, steel, or wood. The columns are spaced according to the weight to be carried. In most cases, the spacing is from 6 to 10 feet. Figure 2-8 shows some of the different types of columns with different types of footing. Wood columns are used in most cases since they are installed with the least time and labor. When wood columns are 3 feet or more above the ground, braces are necessary (fig 2-9).

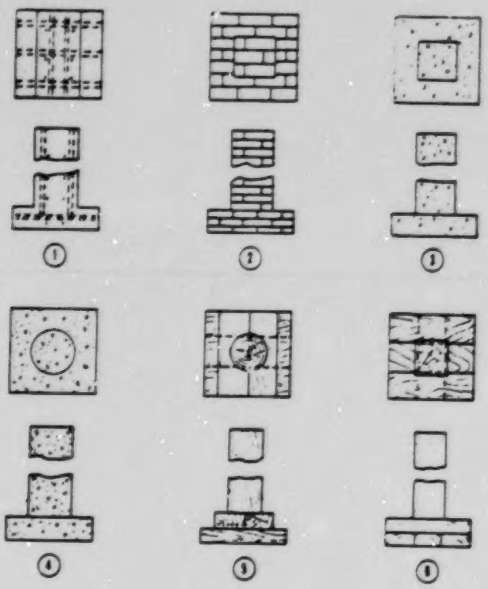


Fig 2-8. Types of columns.

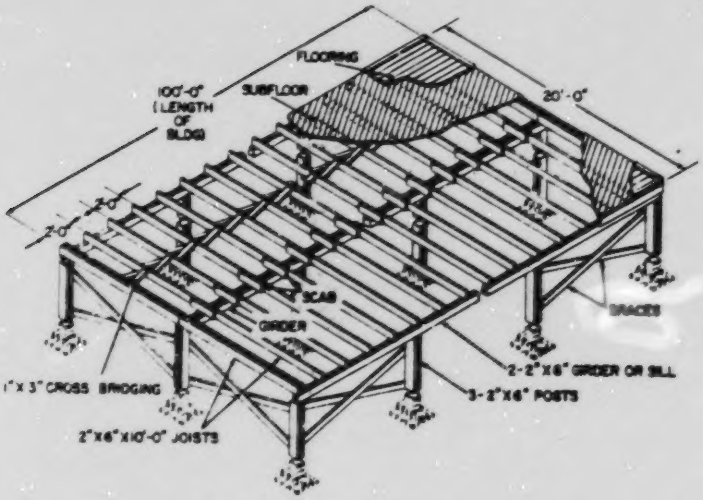

FLOORING
SUBFLOOR
100'-0" (LENGTH OF BLDG)
20'-0"
2'-0"
2'-0"
SCAB
GIRDER
BRACES
2-2"X6" GIRDER OR SILL
3-2"X6" POSTS
1"X 3" CROSS BRIDGING
2"X6"X10'-0" JOISTS

Fig 2-9. Braced columns.

Footings are located by distances between centerlines and distances from reference to property lines. Figure 2-10 shows a typical column foundation plan where footings are used; the conditions for 20- and 60-foot spans are shown. You can see that the spacing of the footings along the 120-foot spans is the same for both conditions. The footing details noted in A2 and B2 on figure 2-10, are shown in figure 2-11. Note that the footing details indicate the size of the various members. In some cases, the lengths are given, while in others the bill of materials accompanying the print specifies the required lengths of the various members. Detail A2 shows the type of footing used for the 60-foot span and detail B2 the type of footing used for the 20-foot span. You can see that the heavier footing construction includes diagonal bracing (detail A2, side elevation), whereas the footing shown in detail B2 uses scabs only. Note that the height of the footing is marked "varies", which means that the height depends upon the ground elevation.

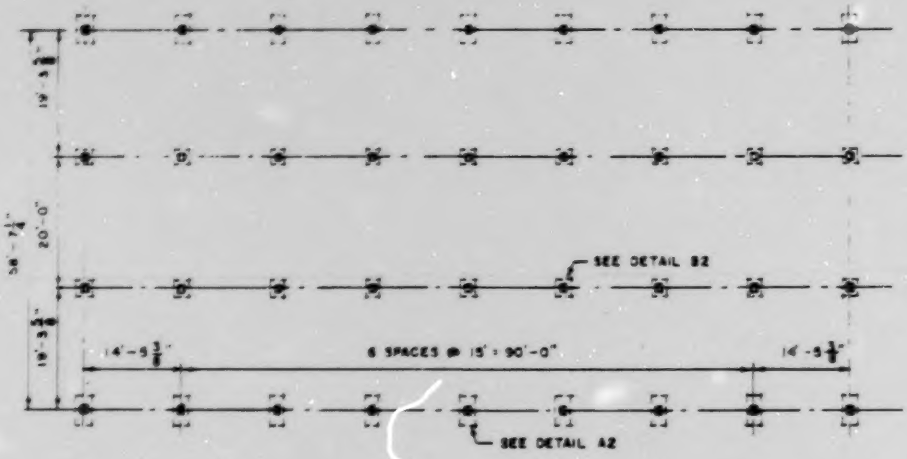

19'-3 3/8"
58'-7 1/4"
20'-0"
19'-3 3/8"
SEE DETAIL B2
14'-5 3/8"
6 SPACES @ 15' = 90'-0"
14'-5 3/8"
SEE DETAIL A2

Fig 2-10. Column foundation plan.

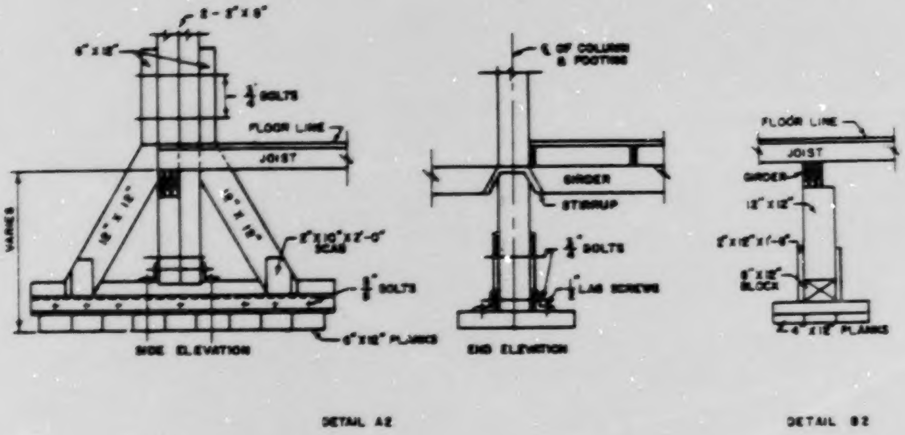

2 - 3" x 8"
6" x 12"
3/4" BOLTS
FLOOR LINE
JOIST
VARIES
12" x 12"
12" x 12"
3" x 10" x 2'-0" SCAB
5/8" BOLTS
6" x 12" PLANKS
SIDE ELEVATION
℄ OF COLUMN & FOOTING
GIRDER
STIRRUP
3/4" BOLTS
LAG SCREWS
END ELEVATION
DETAIL A2
FLOOR LINE
JOIST
GIRDER
12" x 12"
3" x 12" x 1'-6"
6" x 12" BLOCK
4" x 12" PLANKS
DETAIL B2

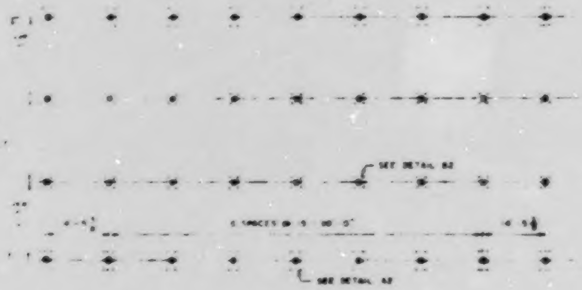
Fig 2-11. Footing details.

EXERCISE: Answer the following items and check your answers with those listed at the end of the study unit.

1. Column foundations will save both time and________________________________.

2. Which type of material is generally used to save time and labor when installing a column foundation?____

3. The illustration below is a___________________________foundation plan.


SEE DETAIL B2
6 SPACES @ 15' = 90'-0"
SEE DETAIL A2

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IDENTIFY, FROM A FOUNDATION PLAN, A WALL FOUNDATION.

Wall footings. Well designed wall footings are important in preventing settling or cracks in the wall. One method for determining the size, which is often used with most normal soils, is based on the proposed wall thickness. The footing thickness or depth should be equal to the wall thickness (fig 2-12). Footings should project beyond each side of the wall one-half of the size of the wall thickness. This is a general rule, of course, as the footing bearing area should be designed in relation to the load capacity of the soil. Local regulations often relate to these needs. This also applies to column and fireplace footings.

If the soil is of low load-bearing capacity, wider reinforced footings may be required.

A few rules that apply to footing design and construction are:

a. Footings must be at least 6 inches thick; 8 inches or more are preferable.

b. If footing excavation is too deep, fill it with concrete - never replace fill.

c. Use form boards for footings where soil conditions prevent sharply cut trenches.

d. Place footings below frostline.

e. Reinforce footings with steel rods where they cross pipe trenches.

f. Use key slot for better resistance to water entry at wall location.

g. In freezing weather, cover with straw or heat the area.

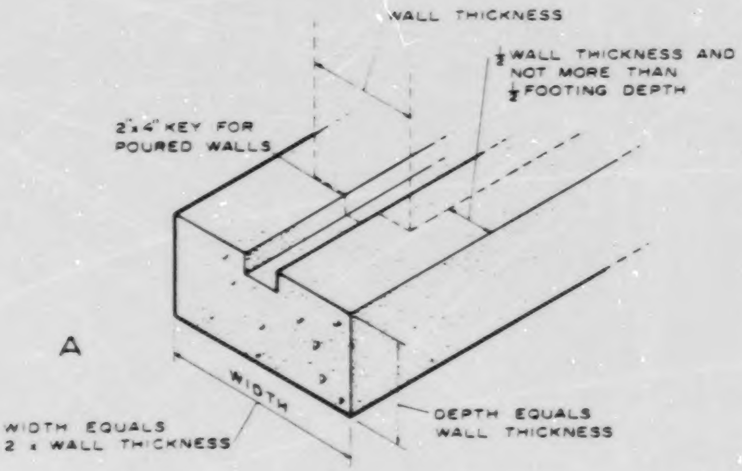

WALL THICKNESS
½ WALL THICKNESS AND NOT MORE THAN ½ FOOTING DEPTH
2"x4" KEY FOR POURED WALLS
A
WIDTH
WIDTH EQUALS 2 x WALL THICKNESS
DEPTH EQUALS WALL THICKNESS

Fig 2-12. Typical concrete wall footing.

Wall foundations. Wall foundations are solidly built all through their length when they are to support heavy loads or when the earth where they are built has low supporting strength. These walls may be made of concrete, rock, brick, or cut stone, with a footing at the bottom (fig 2-13). Because of the time, labor, and material required to build this type of foundation, it will be used in the theater of operation only when other types cannot be used.

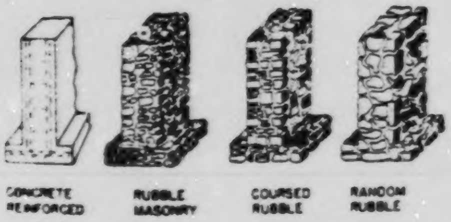


Fig 2-13. Types of wall foundations.

Reading the foundation plan. The various plan views of the foundation will furnish a lot of information that is needed in the construction of a building. In the plan views of a foundation, the footing width is designated by dash-lines and the wall width by an unbroken line. Figure 2-14 shows that the main foundation will be an 8-inch concrete block wall measuring 28 feet lengthwise and 22 feet crosswise. The lower portion of each lengthwise section wall will be 12 inches thick to provide a concrete ledge 4 inches wide for the support of the first floor joist ends.

A girder running through the center of the building will be supported at either end by two 4-inch x 12-inch concrete "pilasters" which will butt against the end foundation walls. Intermediate support for the girder will be provided by two 12-inch x 12-inch concrete "piers" (column), each supported on 18-inch x 18-inch spread footings, 10 inches deep. The dash-lines around the foundation walls indicate that these walls also rest on spread footings; those for the side walls will be 20 inches wide, those for the end walls 16 inches wide.

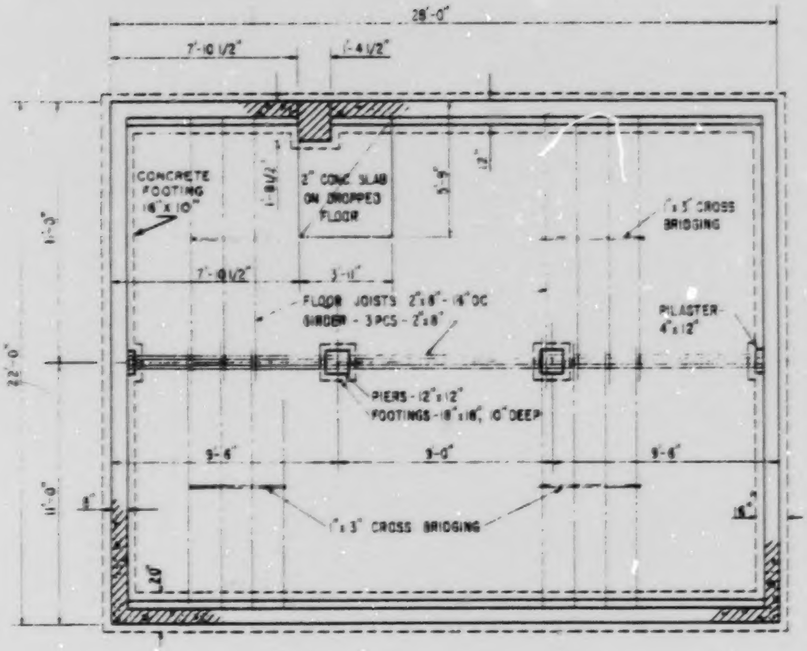

28'-0"
7'-10 1/2"
1'-4 1/2"
CONCRETE FOOTING 16" X 10"
1'-8 1/2"
2" CONC SLAB ON DROPPED FLOOR
5'-9"
12"
1" x 3" CROSS BRIDGING
11'-0"
7'-10 1/2"
3'-11"
FLOOR JOISTS 2" x 8" - 16" OC
GIRDER - 3 PCS - 2" x 8"
PILASTER- 4" x 12"
22'-0"
PIERS - 12" x 12"
FOOTINGS - 18" x 18", 10" DEEP
9'-6"
9'-0"
9'-6"
11'-0"
8"
16"
1" x 3" CROSS BRIDGING
1'-0"

Fig 2-14. Typical wall foundation plan.

EXERCISE: Answer the following items and check your answers with those listed at the end of the study unit.

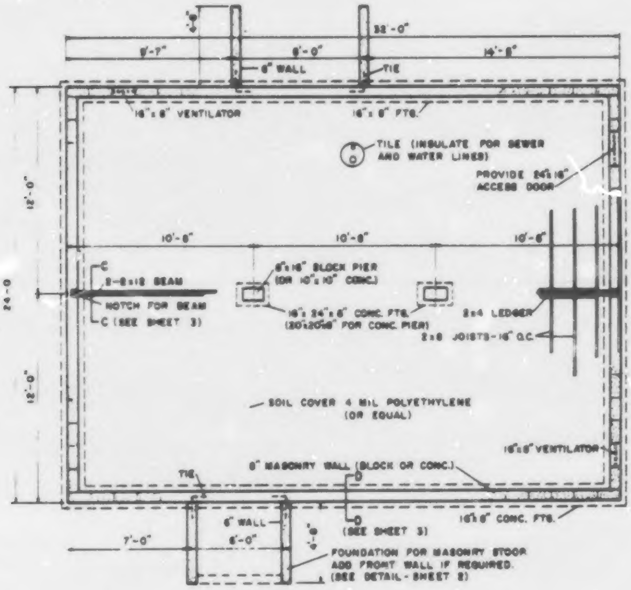
1. Wall foundation footing thickness should be equal to the ______________________.

2. Which type of foundation should not be used in the theater of operations?

   ____

3. Which type of foundation plan is shown in the illustration below?

   ____


32'-0"
9'-7"
6'-0"
14'-5"
6" WALL
TIE
16" x 8" VENTILATOR
16" x 8" FTG.
TILE (INSULATE FOR SEWER AND WATER LINES)
PROVIDE 24"x 16" ACCESS DOOR
12'-0"
24'-0
12'-0"
10'-8"
10'-8"
10'-8"
C
2-2x12 BEAM
NOTCH FOR BEAM
C (SEE SHEET 3)
8"x 16" BLOCK PIER (OR 10"x 10" CONC.)
16"x 24"x 8" CONC. FTG. (20"x20"x8" FOR CONC. PIER)
2x4 LEDGER
2x8 JOISTS-16" O.C.
SOIL COVER 4 MIL POLYETHYLENE (OR EQUAL)
16"x 8" VENTILATOR
8" MASONRY WALL (BLOCK OR CONC.)
TIE
D
D
(SEE SHEET 3)
16"x 8" CONC. FTG.
6" WALL
7'-0"
6'-0"
FOUNDATION FOR MASONRY STOOP ADD FRONT WALL IF REQUIRED. (SEE DETAIL - SHEET 2)

Section III. FLOOR PLANS

A floor plan is a cross-sectional view of a building. The horizontal cut crosses all openings regardless of their height from the floor. The development of a floor plan is shown in figure 2-15. Note that a floor plan shows the outside shape of the building; the arrangement, size, and shape of the rooms; the type of materials; and the length, thickness, and character of the building walls at a particular floor. A floor plan also includes the type, width, and location of the doors and windows; the types and locations of utility installations; and the location of stairways.

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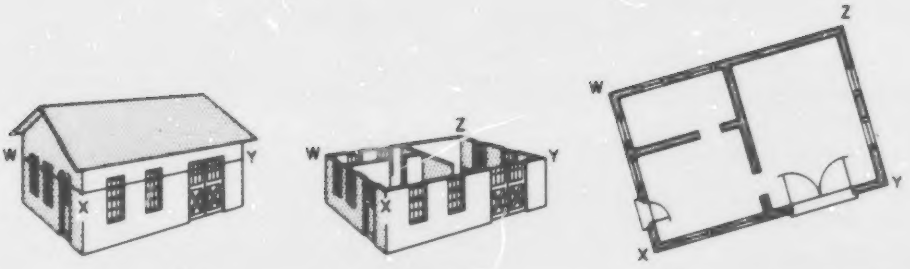

PERSPECTIVE VIEW OF A TYPICAL T.O. BUILDING SHOWING CUTTING PLANE WXYZ

PREVIOUS PERSPECTIVE VIEW AT CUTTING PLANE WXYZ TOP REMOVED

DEVELOPED FLOOR PLAN WXYZ

PLAN DEVELOPMENT TYPICAL T.O. BUILDING

Fig 2-15. Floor plan development.

Work Unit 2-5. FLOOR PLAN SYMBOLS

IDENTIFY, FROM ILLUSTRATIONS, ANY FIVE FLOOR PLAN SYMBOLS.

Floor plan symbols. Architectural symbols on the construction plans are used to indicate the type and location of doors, windows, and many other features. The symbols shown in this work unit are used to represent the different materials, doors, windows, and building parts that will normally be found on floor plans. To read the various floor plans, the builder must be able to recognize the different symbols and he must also know how several types of materials can be used in the same wall.

The architects usually do their best to follow all the accepted standards in representing materials, equipment, and parts of buildings. There may be occasions when more than one symbol could be used. If this happens, the architect will note the symbol and what it represents in a legend on the plan. The American National Standards Institute (ANSI) works with other trade groups and associations to try to standardize the procedures and symbols used in the construction field.

Material symbols. Material symbols show the type of material used in the structure. Figure 2-16 illustrates the ones which are used for the more common types of materials found on a floor plan. The symbol selected will normally represent the material in some way whenever possible; however, it is not always possible to use a common characteristic of the material for symbol. The builder should know all the symbols of the materials to be able to read a construction print, and should always check its meaning if he has any doubt. Figure 2-17 illustrates the symbols of materials that are most often used in combinations.

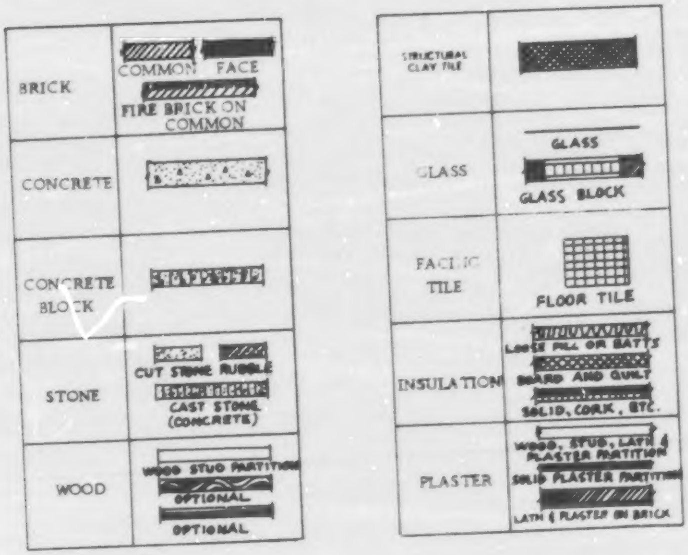
BRICK
COMMON
FACE
FIRE BRICK ON COMMON
CONCRETE
CONCRETE BLOCK
STONE
CUT STONE
RUBBLE
CAST STONE (CONCRETE)
WOOD
WOOD STUD PARTITION
OPTIONAL
OPTIONAL
STRUCTURAL CLAY TILE
GLASS
GLASS
GLASS BLOCK
FACING TILE
FLOOR TILE
INSULATION
LOOSE FILL OR BATTS
BOARD AND QUILT
SOLID, CORK, ETC.
PLASTER
WOOD, STUD, LATH & PLASTER PARTITION
SOLID PLASTER PARTITION
LATH & PLASTER ON BRICK

Fig 2-16. Typical material symbols.

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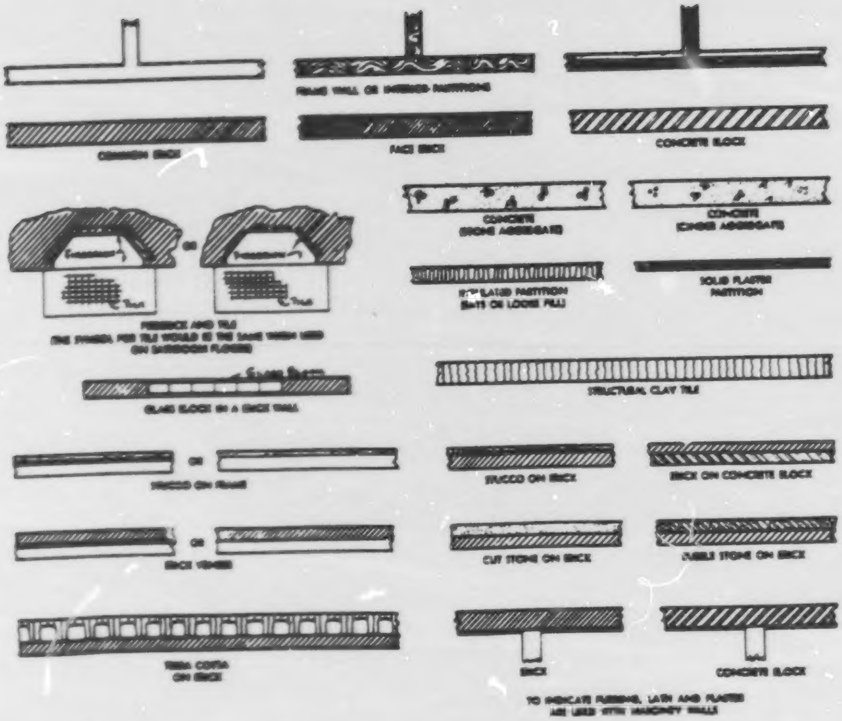

FRAME WALL OR INTERIOR PARTITIONS
COMMON BRICK
FACE BRICK
CONCRETE BLOCK
CONCRETE
(STONE AGGREGATE)
CONCRETE
(CINDER AGGREGATE)
Firebrick
OR
Tile
FIREBRICK AND TILE
(THE SYMBOL FOR TILE WOULD BE THE SAME WHEN USED
ON BATHROOM FLOORS)
INSULATED PARTITION
(BATS OR LOOSE FILL)
SOLID PLASTER
PARTITION
Glass Block
GLASS BLOCK IN A BRICK WALL
STRUCTURAL CLAY TILE
OR
STUCCO ON FRAME
STUCCO ON BRICK
BRICK ON CONCRETE BLOCK
OR
BRICK VENEER
CUT STONE ON BRICK
RUBBLE STONE ON BRICK
TERRA COTTA
ON BRICK
BRICK
CONCRETE BLOCK
TO INDICATE FURRING, LATH AND PLASTER
ARE USED WITH MASONRY WALLS

Fig 2-17. Material symbols used in combination.

Windows and doors. Windows and doors are represented by symbols on a floor plan and often the symbol is accompanied by either a number or a letter which refers to a particular window or door on the appropriate schedule. The schedule consequently will give various information such as the size, material, and the type of door or window.

Figure 2-18 shows both the plan view and the elevation view for five of the most typical windows set in a wood frame wall. The elevation view is included to show the relationship between the two views. The dash-lines on the awning and casement windows point to the side where the window is hinged. As an example the casement window is hinged at the sides and swings out from the middle.

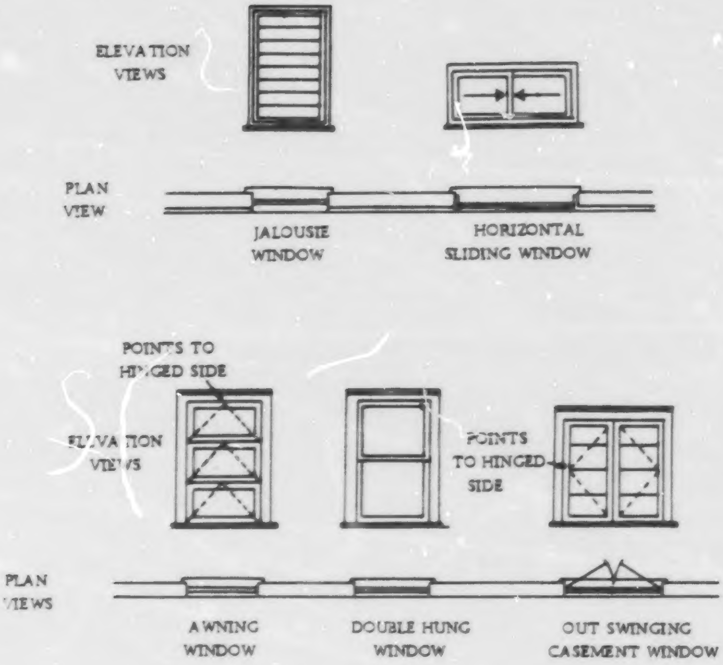

ELEVATION VIEWS
PLAN VIEW
JALOUSIE WINDOW
HORIZONTAL SLIDING WINDOW
POINTS TO HINGED SIDE
ELEVATION VIEWS
POINTS TO HINGED SIDE
PLAN VIEWS
AWNING WINDOW
DOUBLE HUNG WINDOW
OUT SWINGING CASEMENT WINDOW

Fig 2-18. Typical window symbols.

On floor plans, a door is normally shown as a line. It can slide into the wall or it can swing out from the wall. To show the direction of the swing for a hinged door, the architect will draw an arch showing the sweep of the outer edge of the door. Plan views of the most typical doors used are shown in figure 2-19.

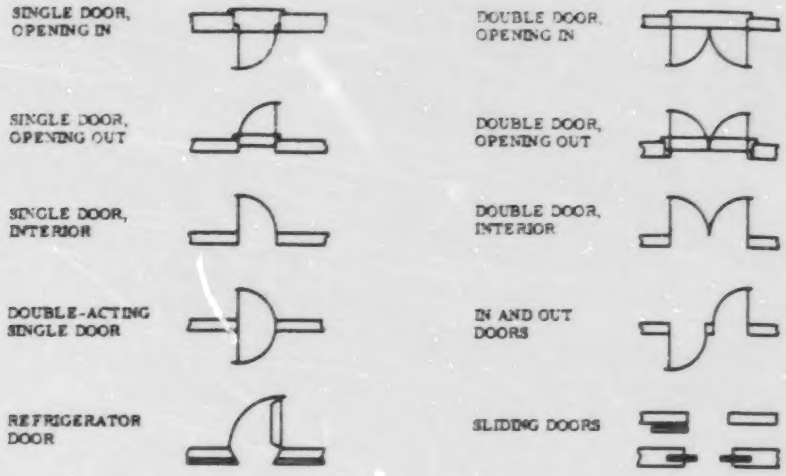

SINGLE DOOR, OPENING IN
DOUBLE DOOR, OPENING IN
SINGLE DOOR, OPENING OUT
DOUBLE DOOR, OPENING OUT
SINGLE DOOR, INTERIOR
DOUBLE DOOR, INTERIOR
DOUBLE-ACTING SINGLE DOOR
IN AND OUT DOORS
REFRIGERATOR DOOR
SLIDING DOORS

Fig 2-19. Typical door symbols.

Stairs. Stair symbols (fig 2-20) are drawn as if you were looking down vertically on a flight of stairs. The stringers are represented by two parallel lines spaced proportionally to the stairway width. The treads are formed by parallel lines drawn at right angles to the stringer lines, the number of spaces representing the number of treads. An arrow is located midway between the stringers and is labelled UP or DN to show the direction of the stairs from the floor shown in the plan. The UP and DN will be preceded by a number giving the amount of risers in the run. For example, 17DN followed by an arrow means that there are 17 risers in the run of stairs proceeding from the floor shown on the plan to the floor below in the direction indicated by the arrow.

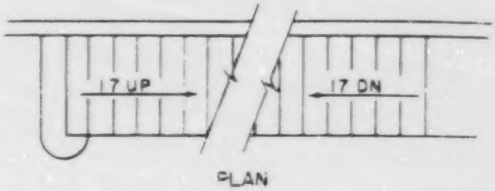

17 UP
17 DN
PLAN

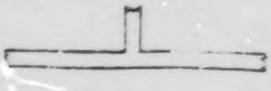
Fig 2-20. Plan view of stairway.

Miscellaneous. Specialized symbols used to show heating, air conditioning, plumbing, and electricity will be covered in study unit 4.

EXERCISE: Answer the following questions about the illustrations and then compare your answers with the answers at the end of the study unit.

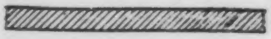
1. The symbol illustrated below is the symbol representing

____.



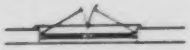
2. The symbol below represents what type of material?

____.



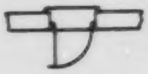
3. What type of window is represented by the symbol illustrated below?

____.



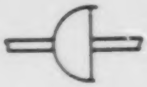
4. What type of door is represented by the symbol illustrated below?

____.

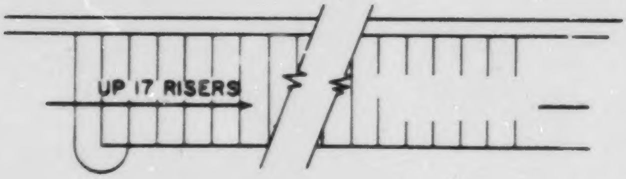


5. The illustration below is the symbol for a

____.



6. What is represented by the symbol illustrated below?



Work Unit 2-6. FLOOR PLAN ABBREVIATIONS

MATCH, FROM A LIST OF TERMS, ANY THREE FLOOR PLAN ABBREVIATIONS.

Floor plan abbreviations. The architect works on such a small scale that he does not have the space to letter all the information; therefore, he uses abbreviations whenever he can. Because the person reading the construction print may be new and inexperienced, there is the danger that he may not be able to understand the abbreviations. Most architects will use an accepted form of abbreviations, but if there is any doubt he will spell out the words completely. Sometimes an abbrevation may have more than one meaning. The abbreviation "FL" can stand for "floor" or "flush"; therefore, the builder must be very careful and make sure to understand the abbreviation fully. If there is any doubt, he should check with the architect for the correct meaning.

Table 2-1. contains most of the accepted abbreviations found on a floor plan. Specialized abbreviations used in conjunction with heating, air conditioning, plumbing, and electricity will be discussed in study unit 4.

Table 2-1. Floor plan abbreviations

TERM	ABBREVIATIONS	TERM	ABBREVIATIONS
Acoustic	ACST	Cellar	CEL
Acoustical Tile	AT	Cement	CEM
Aggregate	AGGR	Cement Floor	CEM FL
Aluminum	AL	Cement Mortar	CEM MORT
Anchor Bolt	AB	Center	CTR
Apartment	APT	Center to Center	C to C
Approximate	APPROX	Center Line	℄ or CL
Architectural	ARCH	Ceramic	CER
Area	A	Channel	CHAN
Asbestos	ASB	Cinder Block	CIN BL
Asphalt	ASPH	Clear Glass	CL GL
Asphalt Tile	AT	Closet	C, CL or CLO
Basement	BSMT	Column	COL
Bathroom	B	Concrete	CONC
Bath Tub	BT	Concrete Block	CONC B
Beam	BM	Concrete Floor	CONC FL
Bedroom	BR	Construction	CONST
Blueprint	BP	Contract	CONT
Book Shelves	BK SH	Copper	COP
Brass	BRS	Counter	CTR
Brick	BRK	Cubic Feet	CU FT
Bronze	BRZ	Cut Out	CO
Broom Closet	BC	Detail	DET
Building	BLDG	Diagram	DIAG
Building Line	BL	Dimension	DIM
Cabinet	CAB.	Dining Room	DR
Calking	CLKG	Dishwasher	DW
Cast Iron	CI	Double-Acting	DA

Table 2-1. Floor plan abbreviations (cont'd)

TERM	ABBREVIATIONS
Cast Stone	CS
Down	DN
Downspout	DS
Drawing	DWG
Dryer	D
End to End	E to E
Excavate	EXC
Expansion Joint	EXP JT
Exterior	EXT
Finish	FIN.
Finished Floor	FIN. FL
Firebrick	FBRK
Fireplace	FP
Fireproof	FPRF
Flashing	FL
Floor	FL
Flooring	FLG
Flush	FL
Footing	FTG
Foundation	FND
Frame	FR
Full Size	FS
Furring	FUR
Galvanized Iron	GI
Garage	GAR
Gas	G
Glass	GL
Glass Block	GL BL
Gypsum	GYP
Hardware	HDW
Hot Water Heater	HWH
I Beam	I
Inside Diameter	ID
Insulation	INS
Interior	INT
Iron	I
Jamb	JB
Kitchen	K
Landing	LDG
Laundry	LAU
Lavatory	LAV
Leader	L
Length	L, LG or LGTH
Library	LIB
Limestone	LS
Linen Closet	L CL
Lining	LN
Linoleum	LINO
Living Room	LR
Louver	LV
Main	MN
Marble	MR
Material	MATL
Maximum	MAX
Medicine Cabinet	MC
Minimum	MIN
Miscellaneous	MISC
Mixture	MIX
Modular	MOD
Mortar	MOR
Moulding	MLDG
Nosing	NOS
Obscure Glass	OBSC GL
On Center	OC
Opening	OPNG
Outlet	OUT
Overhead	OVHD
Pantry	PAN.
Double Strength Glass	DSG
Partition	PTN
Plaster	PL or PLAS
Plate	PL
Platform	PLAT
Porch	P
Precast	PRCST
Prefabricated	PREFAB
Quarry Tile Floor	QTF
Random	RDM
Range	R
Recessed	REC
Refrigerator	REF
Reinforce or Reinforcing	REINF
Revision	REV
Riser	R
Roof	RF
Room	RM or R
Rough	RGH
Rough Opening	RGH OPNG
Rubber Tile	R TILE
Scale	SC
Schedule	SCH
Screen	SCR
Scuttle	S
Section	SECT
Select	SEL
Service	SERV
Sewer	SEW.
Sheathing	SHTHG
Sheet	SH
Shelf and Rod	SH & RD
Shelving	SHELV
Shower	SH
Sink	SK or S
Specification	SPEC
Square Feet	SQ FT
Stained	STN
Stairs	St
Stairway	STWY
Standard	STD
Steel	STL
Storage	STG
Switch	SW or S
Telephone	TEL
Terra Cotta	TC
Terrazzo	TER
Thermostat	THERMO
Threshold	TH
Toilet	T
Tongue and Groove	T & G
Tread	TR or T
Typical	TYP
Unfinished	UNF
Unexcavated	UNEXC
Utility Room	URM
Vinyl Tile	V TILE
Washing Machine	WM
Water	W
Water Closet	WC
Water Heater	WH
Waterproof	WP
Weather Stripping	WS
Wide Flange	WF
Wood	WD
Wood Frame	WF

EXERICSE: Column 1 below lists floor plan abbreviations. Column 2 lists floor plan terms. In the numbered blanks to the left of the abbreviations, write in the matching term for the abbreviation. Compare your answers with the answers at the end of the study unit.

Column 1 ABBREVIATIONS	Column 2 TERMS
1. ____________, APT	Water Closet Shelving
2. ____________, BT	Construction Overhead
3. ____________, CONC	Firebrick Approximate
4. ____________, FBRK	Threshold Bath Tub
5. ____________, OC	Platform Sheathing
6. ____________, PL	Rough Thermostat
7. ____________, RF	Basement Concrete
8. ____________, SHTHG	Water Counter Roof
9. ____________, TH	Plate Apartment
10. ____________, WC	On Center

Work Unit 2-7. READING FLOOR PLANS

IDENTIFY THE SIZE, SHAPE, AND RELATIONSHIP OF ANY ROOM ON A FLOOR PLAN.

IDENTIFY ANY AUXILIARY SPACE ON A FLOOR PLAN.

IDENTIFY, FROM A FLOOR PLAN, THE NUMBER OF STORIES IN A BUILDING.

Reading floor plans. The first thing a builder will normally do with a set of prints is to become familiar with the layout of the building. This can be accomplished by studying the floor plan(s) of the building. Since the floor plan(s) can contain a maze of information, he will usually concentrate on the overall size, shape, and relation of rooms; as well as the use of any auxiliary space such as hallways, closets, and stairways. Many times a print will contain so much information that it may become necessary to block out most of the trade information. This will allow the builder to see the size, shape, and relationship of the rooms and any auxiliary spaces. You should try to visualize the building as you enter the front door. From this point you can visually travel from room to room and determine the location of all windows, doors, closets, cabinets and stairways.

Basic rules in reading floor plans. The following are some basic rules that can be applied to reading floor plans:

1. Floor plans are drawn to exact scale; therefore, all rooms and stairways will be drawn so that they are in the right relationship to each other.

2. Floor plans are drawn to the same scale as the one for elevation drawings and they will be exactly related to each other. Doors and windows shown on the floor plan will be the same in size and location as those on the elevation view.

3. If a building has more than one floor plan (two or more floors), then these floor plans will be related to one another. Partitions on the lower floor will support the floor load directly above. Stairways will start on one floor level and end on the floor above in the correct place. If a stairway is noted on one floor plan, then another floor plan for the other level must be available. The stairway will only be partially shown on either the first or second floor plans. If the first floor plan should show a set of stairs descending, then there must be a basement in the building.

4. The building on a floor plan will normally be shown with the front view toward the bottom of the print.

Read the floor plan shown in figure 2-21 and note the features of the recreation building. Although the location of the utilities is given, you can disregard the details on utilities in this work unit. Basically, the lines with small circles show wiring for electrical outlets, while other appropriate symbols designate the plumbing fixtures. Complete information on reading the utility data and interpretation of the associated symbols are given in study unit 4.

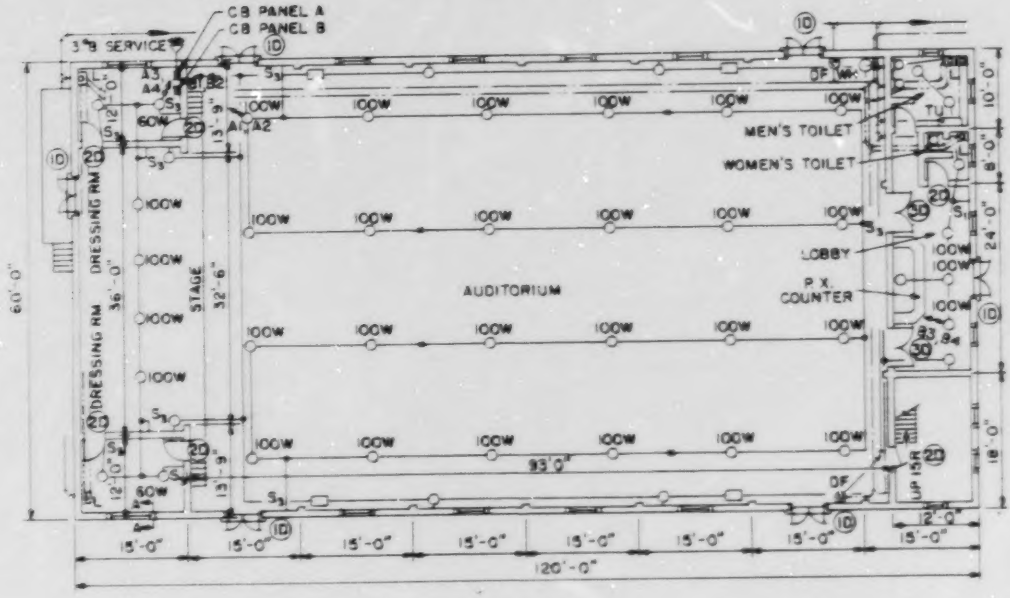
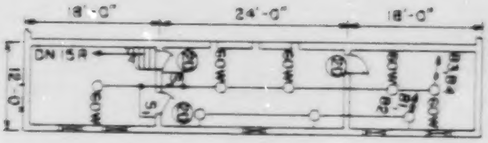

CB PANEL A
CB PANEL B
3ΦB SERVICE
A3
A4
B1 B2
A1 A2
S_3
60W
100W
DRESSING RM
DRESSING RM
STAGE
AUDITORIUM
MEN'S TOILET
WOMEN'S TOILET
LOBBY
P.X. COUNTER
DF
WH
TU
S_1
B3, B4
UP 15R
10
20
30
60'-0"
36'-0"
32'-6"
13'-9"
13'-9"
12'-0"
12'-0"
93'-0"
10'-0"
8'-0"
24'-0"
18'-0"
12'-0"
15'-0"
120'-0"

Fig 2-21 Typical floor plan.

By examining the floor plan, you can see that the interior of the building will consist of an auditorium, a lobby with a P.X. counter, a men's toilet, a women's toilet, a projection room (fig 2-22) on a second level above the lobby, two dressing rooms and a stage. The stage may not be apparent, but, by noting the steps adjacent to each dressing room you can see that there is a change in elevation. The plan gives the dimensions of the areas specified. Note that all building entrances and/or exit doors are of the same type (1D) and that all windows are the double-hung type. All interior single doors (2D) are the same and two double doors (3D) open into the lobby from the auditorium. The projection room is reached via a 15-riser stairway located in a 12 by 18 foot room. Access to this room is made from the auditorium through a single door opening into the room. At the top of the stairway a single door opens into the projection room. The wall of the projection room that faces the stage (inside wall) has three openings. Note that no windows are designated for the sides of the building where the projection room is located, but are indicated at the first floor level.

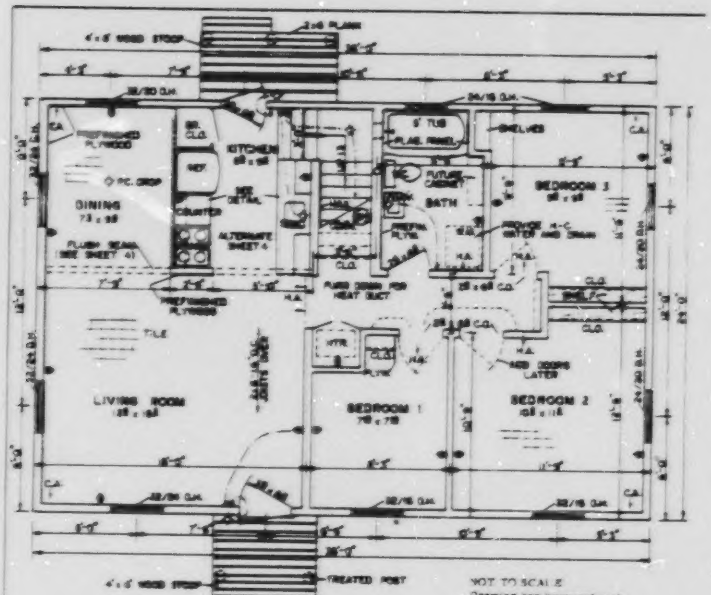


PROJECTION ROOM

Fig 2-22. Second floor plan.

EXERCISE: Answer the following questions and compare your answers with the answers at the end of the study unit.

NOTE: Questions 1 through 8 refer to the floor plan illustrated below.


4'x6' WOOD STOOP
2x6 PLANK
C.A.
PREFINISHED PLYWOOD
BR. CLO.
KITCHEN
REF
PC. DROP
DINING
SEE DETAIL
COUNTER
ALTERNATE SHEET 4
FLUSH BEAM (SEE SHEET 4)
PREFINISHED PLYWOOD
CLO.
H.A.
FURR DOWN FOR HEAT DUCT
TILE
LIVING ROOM
HTR.
BEDROOM 1
5' TUB
FUTURE CABINET
BATH
SHELVES
BEDROOM 3
PROVIDE A-C WATER AND DRAIN
SHELF
ADD DOORS LATER
BEDROOM 2
4'x6' WOOD STOOP
TREATED POST

NOT TO SCALE
Drawing has been reduced to fit page

FIRST FLOOR PLAN
SCALE - 1/4"=1'-0"

1. How many doors permit entry or exit to the house?

____.

2. How many bedrooms are there in the house?

____.

3. What is the finished size of bedroom #3?

____.

BEST COPY AVAILABLE

4. What is the total number of closets in the house?

____.

5. What are the finished dimensions of the living room?

____.

6. How many risers are there in the stairs going up to the second floor level?

____.

7. As you enter the kitchen from the living room, on what side of the room is the sink located?

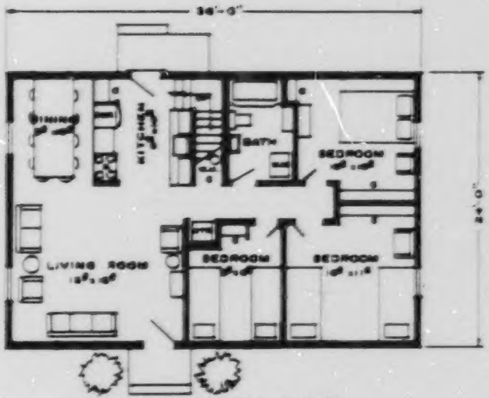
____.

8. What auxiliary space can be found next to the right side of the refrigerator?

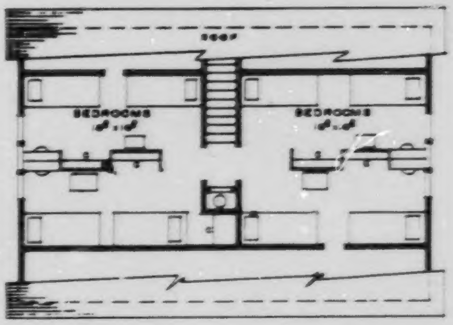
____

9. How many stories are in the house as shown by the floor plan(s) below?

____


36'-0"
DINING
KITCHEN
BATH
BEDROOM
LIVING ROOM
BEDROOM
BEDROOM
24'-0"

FIRST FLOOR


ROOF
BEDROOMS
BEDROOMS

SECOND FLOOR

10. What may you safely assume when you see a set of stairs running down on a first floor plan? ________________________________

Section IV. ELEVATION DRAWINGS

Elevation drawings are the exterior views of a structure and they may be taken from the front, rear, right or left side. Being projections on a vertical plane, they show a picture-like view of the structure as it actually is and not as it would appear to the eye. The basic function of the elevation drawing is to show the design of the building, what materials are to be used, and where the doors and windows are to be located.

Work Unit 2-8. ELEVATION SYMBOLS

IDENTIFY, FROM AN ILLUSTRATION, ANY FIVE ELEVATION SYMBOLS.

Elevation drawing symbols. Elevation drawings have also a wide variety of symbols that will represent the different types of materials, doors, windows, and other features of a structure.

The symbols used by the architect on the elevation drawing will normally be of a standard accepted type used in the trade. Most of the symbols used are standardized; however, occasionally the architect will use a non-standard symbol. When a non-standard symbol is used, the architect will note what that symbol represents.

Material symbols. Material symbols used on elevation drawings are similar to the material symbols found on floor plans. The symbol will represent the material in some way when possible. If there is any question about what a symbol represents, then the architect should be contacted to explain its meaning. Figure 2-23 shows some of the more common material symbols used on elevation drawings. You should note that some materials may have more than one symbol and some symbols look very much alike. This can and does cause a lot of confusion if the builder is not careful. Make sure that the drawing is checked for any notes about material symbols that the architect may have included.

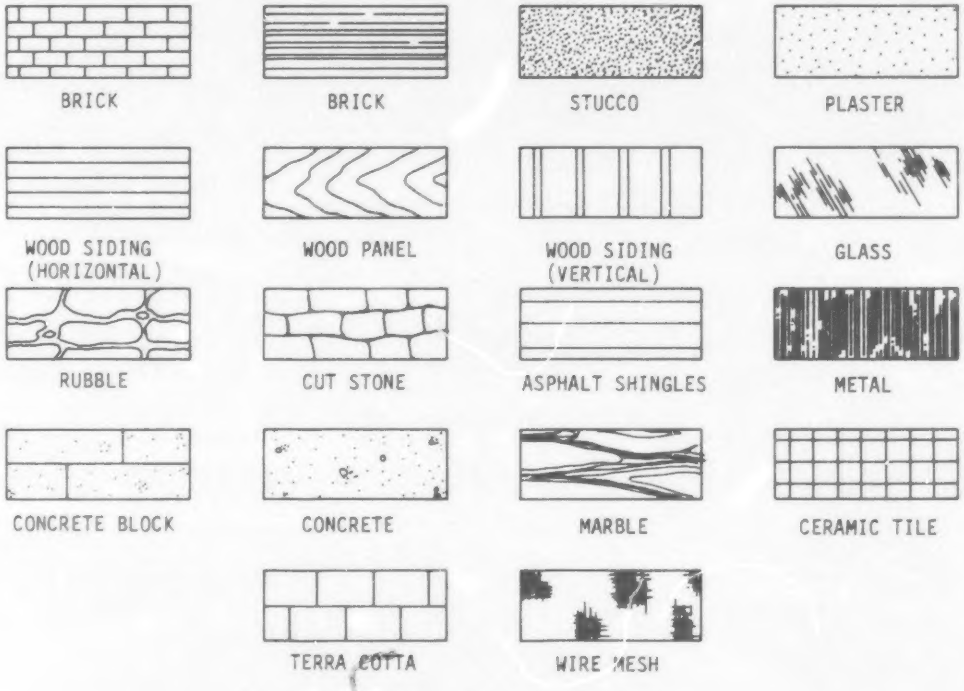


Fig 2-23. Material symbols.

Window and doors. Elevation drawings will show window and door symbols as they appear in the wall in their exact location. A door or window schedule number or letter may appear by the symbol to show that additional information can be found on the appropriate schedule.

Figure 2-24 shows some of the most common types of windows found on an elevation drawing. The plan view of the window is included to show the relationship between the two views. Note that the dashed lines on the casement and awning windows point to the side where it is hinged.

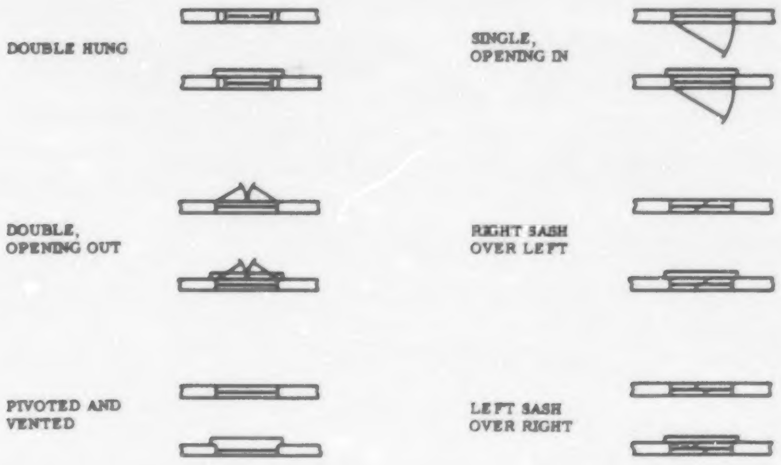


Fig 2-24. Typical window symbol on elevation drawing.

Figure 2-25 illustrates some of the most common types of door symbols that will be found on elevation drawings. Doors in the traditional pattern are usually the panel type (fig 2-25, A). They consist of stiles (solid vertical members), rails (solid cross members), and filler panels in a number of designs. Glass upper panels are combined with raised wood or plywood lower panels. Flash doors (fig 2-25, B) consist of thin plywood faces over a framework of wood with a woodblock or particle board core. Wood combination doors (storm and screen) will occasionally be shown on elevation views (fig 2-25, C). Panels which include screen and storm inserts are normally located in the upper portion of the door.

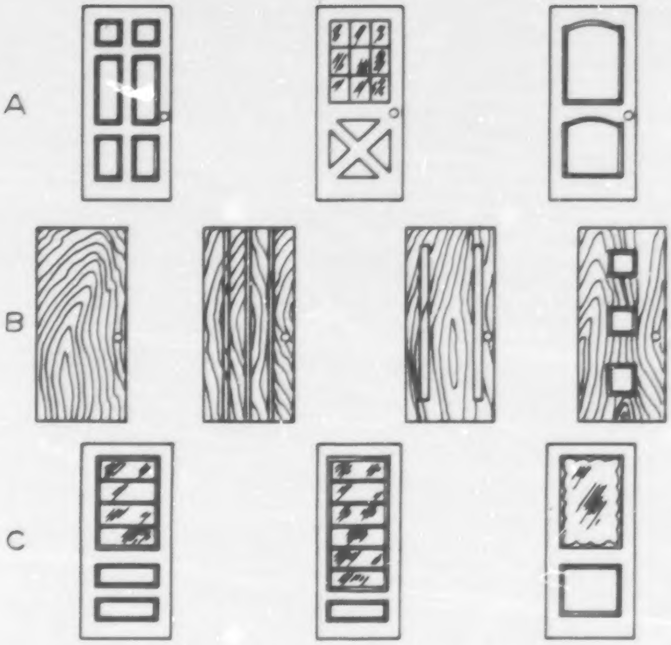
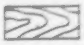


Fig 2-25. Typical door symbols: A, panel; B, flush; C, combination.

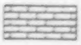
Miscellaneous. There are many things that can be shown on an elevation drawing to help a builder locate certain items. Utility outlets and fixtures can be shown to locate their positions in the building; however, the utility symbols will not be discussed in this work unit. Many items such as gutters, downspouts, metal flashing, chimneys, or any other distinguishable feature will be shown on the elevation view. These items are drawn to resemble themselves, and therefore, need no symbols.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

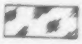
1. The symbol illustrated below is the symbol for a ______________________________.



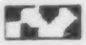
2. What material is illustrated by the symbol below? ______________________________.



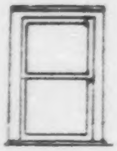
3. What material is illustrated by the symbol below? ______________________________.



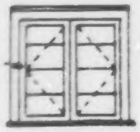
4. The symbol below represents what material? ________________________________.



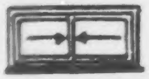
5. The illustration below is the symbol for a ________________________________.



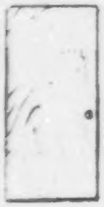
6. What type of window is illustrated by the symbol below? ____________________.



7. The illustration below is the symbol for a ________________________________.



8. The illustration below is the symbol for a ________________________________.



Work Unit 2-9. ELEVATION ABBREVIATIONS

MATCH, FROM A LIST OF TERMS, ANY THREE ELEVATION ABBREVIATIONS.

Elevation drawing abbreviations. Elevation drawings will also show standard abbreviations . As noted in work unit 2-6, which contains floor plan abbreviations, elevation drawing abbreviations are used when the architect does not have enough space to letter all of the information. If you have any doubt about an abbreviation, you should check with the architect.

Table 2-2 contains most of the accepted abbreviations used in an elevation drawing. Many of the abbreviations are the same as those used on a floor plan. Utility drawing abbreviations will be covered in study unit 4.

Table 2-2. Abbreviations used on elevation views.

TERM	ABBREVIATIONS	TERM	ABBREVIATIONS
Aluminum	AL	Downspout	DS
Asbestos	ASB	Drawing	DWG
Asphalt	ASPH	Drip Cap	DC
Basement	BSMT	Each	EA
Bevel	BEV	East	E
Brick	BRK	Elevation	El
Building	BLDG	Entrance	ENT
Cast Iron	CI	Excavate	EXC
Ceiling	CLG	Exterior	EXT
Cement	CEM	Finish	FIN.
Center	CTR	Flashing	FL
Center Line	or CR	Floor	FL
Clear	CLR	Foot or Feet	or FT
Column	COL	Foundation	FND
Concrete	CONC	Full Size	FS
Concrete Block	CONC B	Galvanized	GALV
Copper	COP	Galvanized Iron	GI
Corner	COR	Gauge	GA
Detail	DET	Glass	GL
Diameter	DIA or o	Glass Block	GL BL
Dimension	DIM.	Grade	GR
Divided	DIV	Grade Line	GL
Door	DR	Height	HGT or H or HT
Double-Hung Window	DHW	High Point	H PT
Down	DN or D	Horizontal	HOR
Inch or Inches	" or IN.	Scale	SC
Insulating (Insulated)	INS	Schedule	SCH
Length	LGTH, LG or L	Section	SECT
Long	LG	Sheathing	SHTHG
Louver	LV	Sheet	SH
Low Point	LP	Shiplap	SHLP
Masonry Opening	MO	Siding	SDG
Metal	MET or M	South	S
Molding	MLDG	Specifications	SPEC
North	N	Square	SQ or
Number	NO. or #	Square Inch	SQ IN. or
Opening	OPNG	Stainless Steel	SST
Outlet	OUT	Steel	STL
Outside Diameter	OD	Stone	STN
Overhead	OVHD	Terra Cotta	TC
Panel	PNL	Thick or Thickness	THK or T
Plate Glass	PL GL	Typical	TYP
Plate Height	PL HT	Vertical	VERT
Radius	R	Waterproofing	WP
Revision	REV	West	W
Riser	R	Width	W or WTH
Roof	RF	Window	WDW
Roof Drain	RD	Wire Glass	W GL
Roofing	RFG	Wood	WD
Rough	RGH	Wrought Iron	WI
Saddle	SDL or S		

EXERCISE: Column 1 below lists elevation abbreviations. Column 2 lists elevation terms. In the numbered blanks to the left of the abbreviations, write in the matching term for the abbreviation. Compare your answer with the answers given at the end of the study unit.

Column 1

ABBREVIATIONS

1. ______________, E
2. ______________, GL
3. ______________, COR
4. ______________, N
5. ______________, FND
6. ______________, WDW
7. ______________, SH
8. ______________, LG
9. ______________, TC
10. ______________, EL

Column 2

TERMS

Window
Sheathing

Length
Elevation

Sheet
Glaze

Width
East

Glass
Column

Foundation
Number

Corner
Long

North
Each

Top Center
Elevation

Flashing
Terra Cotta

Work Unit 2-10. READING ELEVATIONS DRAWINGS

IDENTIFY, FROM AN ELEVATION DRAWING, THE TYPE OF ROOF USED.

IDENTIFY, FROM AN ELEVATION DRAWING, THE SLOPE USED ON A ROOF.

IDENTIFY, FROM AN ELEVATION DRAWING, THE TYPE OF WINDOW(S) USED.

IDENTIFY, FROM AN ELEVATION DRAWING, THE TYPE OF DOOR(S) USED.

IDENTIFY, FROM AN ELEVATION DRAWING, THE TYPE OF EXTERIOR FINISH USED ON A BUILDING.

As stated earlier, an elevation drawing is an exterior view of a structure and may be taken from the front, rear, right, or left side. Front, rear, right side, and left side elevations of a small building are shown in figure 2-26. Exterior materials; height of doors, windows, and rooms; the type and slope of the roof; and the surrounding ground level can be shown in elevation views. On an elevation view for a single story building, the floor level is located in reference to the surrounding ground level or finished grade as shown in figure 2-26. Additional floors above the first floor are located by dimensions between finished floor surfaces. If the sides of the building are not identical, an elevation for each side must be drawn. If you had access to a plan, you could see that the dimensions given are practically all vertical measurements. However, horizontal dimensions may be placed on an elevation view if it is not possible to show them on a plan view.

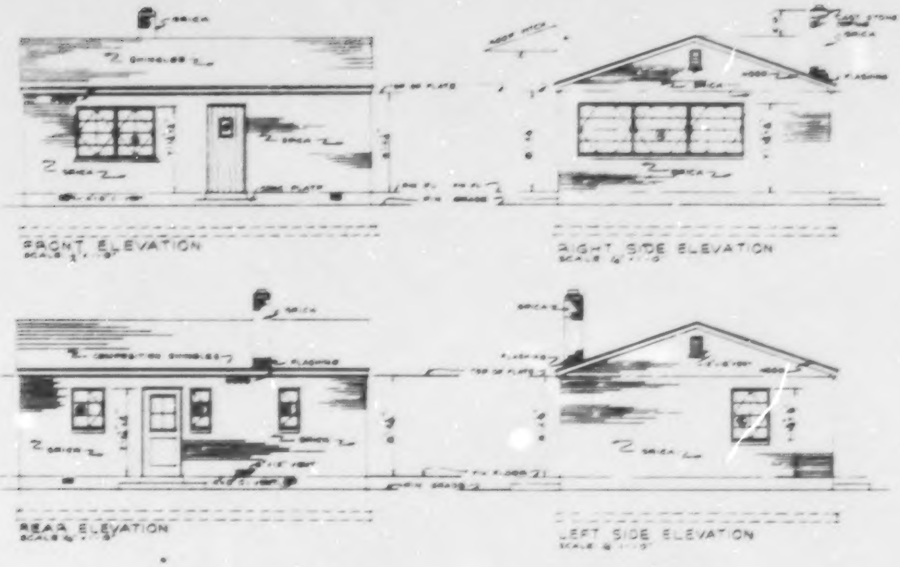

FRONT ELEVATION
RIGHT SIDE ELEVATION
REAR ELEVATION
LEFT SIDE ELEVATION

Fig 2-26. Typical elevation views of a building.

The centerline symbol of alternate long and short dashes in an elevation indicates the finished floor lines. Foundations below grade are shown by the hidden line symbol of short evenly spaced dashes. Note in figure 2-26 that the footing and foundation are shown below grade. Many times the elevation view will give the dimension between the finished floor level and the finished ceiling level for that floor, or as shown in figure 2-26 the top of the wall plate. Figure 2-26 also shows the dimensions from finished floor to the top of the doors and windows.

Roof types of styles. The primary object of a roof in any climate is to keep out the rain and the cold or heat; however, it also serves an artistic purpose. This is quite apparent by the different types of roofs found on buildings. The architectural style of a house often determines the type of roof and roof slope which are best suited. A contemporary design may have a flat or slightly pitched roof; a rambler or ranch style, an intermediate slope; and a Cape Cod cottage, a steep slope. Generally, however, the two basic types are called flat or pitched, defined as (a) flat or slightly pitched roofs in which roof and ceiling supports are furnished by one type of member, and (b) pitched roofs where both ceiling joists and rafters or trusses are required.

Flat or low-pitched roofs, usually known as shed roofs, can take a number of forms, two of which are shown in figure 2-27.

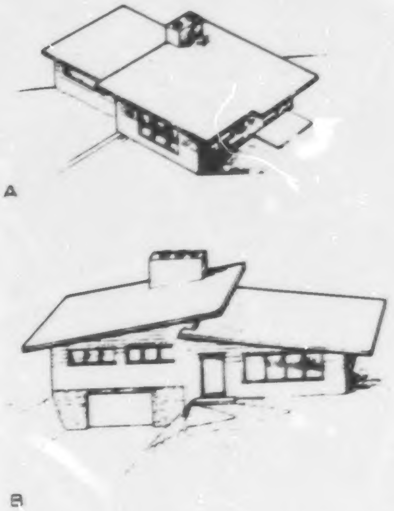


Fig 2-27. A, Flat roof; B, double low-pitched (shed) roof.

There are several types of pitched roofs. Perhaps the simplest and most common of these is the gable roof (fig 2-28, A). A variation of the gable roof, used for Cape Cod or similar style houses, includes the use of shed and gable dormers (fig 2-28, B). A third style in roof design is the hip roof (fig 2-28, C).

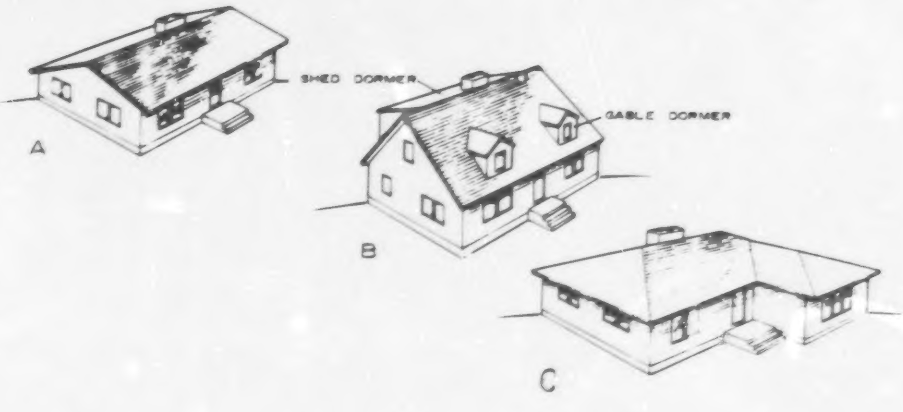


Fig 2-28. A, Gable roof; B, gable with dormer;
C, hip roof.

Combinations of the various types can be used together. Gable and valley roof (fig 2-29) is a combination of two gable roofs intersecting each other. Many times a combination of hip roof intersecting with a gable roof may be used (fig 2-30).

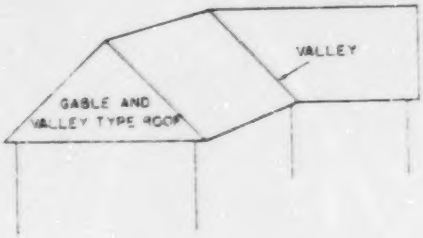


Fig 2-29. Combination gable and valley roof.

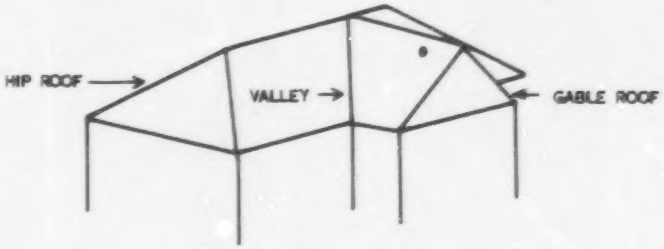


Fig 2-30. Combination hip and gable roof.

Roof slope. The slope of a roof is very important when the snow weight and the rain run off are considered. The slope or pitch of the roof is generally expressed as the number of inches of vertical rise in 12 inches of horizontal run. The rise is given first, for example 8 in 12. The run will always be expressed as 12. Figure 2-31 shows some of the different slopes that could be found on a building. They range from a 4 in 12 to a 24 in 12 slope.

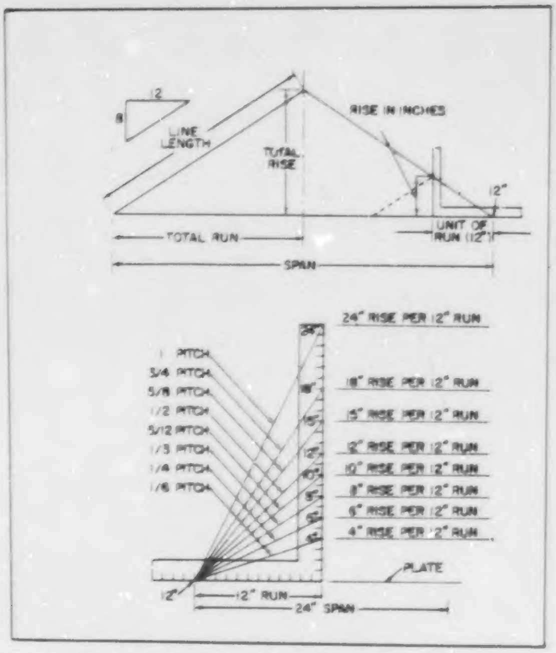

12
8
LINE LENGTH
TOTAL RISE
RISE IN INCHES
8"
12"
UNIT OF RUN (12")
TOTAL RUN
SPAN
24" RISE PER 12" RUN
18" RISE PER 12" RUN
15" RISE PER 12" RUN
12" RISE PER 12" RUN
10" RISE PER 12" RUN
8" RISE PER 12" RUN
6" RISE PER 12" RUN
4" RISE PER 12" RUN
1 PITCH
3/4 PITCH
5/8 PITCH
1/2 PITCH
5/12 PITCH
1/3 PITCH
1/4 PITCH
1/6 PITCH
24"
18"
15"
12"
10"
8"
6"
4"
PLATE
12"
12" RUN
24" SPAN

Fig 2-31. Determining roof slope.

The roof slope or pitch will normally be indicated on an elevation view by a triangle with a numerical ratio of rise to run (fig 2-32). This triangle will usually appear next to the roof line of the building in the elevation view.

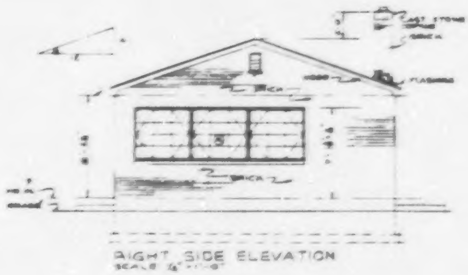

CAST STONE
BRICK
FLASHING
BRICK
BRICK
RIGHT SIDE ELEVATION

Fig 2-32. Roof slope indicated by a triangle and numerical ratio.

Elevation view openings. Elevation drawings will contain a lot of information about windows, doors, and other types of openings. Horizontal locating dimensions will not be included on elevation drawings; therefore, openings are located by referring to the floor plans.

Windows will appear in their exact location on an elevation view. Symbols used to represent the most common types were shown in work unit 2-8. The most common types are double hung, casement, awning, horizontal sliding, and jalousie. Elevation views will show where a window is hinged by the use of dash-lines.

Sometimes a window may be coded with a number or a letter. This refers the builder to a window schedule. The window schedule can contain such information as size, rough opening, window type, material, number of windows, and any additional remarks needed. Figure 2-33 shows the relationship between a coded window and a window schedule.

WINDOW SCHEDULE

MARK	SIZE	TYPE	QTY	REMARKS
W-1	2'-8¾" x 4'-0"	WD. GLIDING	7	DB GLASS
W-2	4'-10" x 4'-6"	WD. DBL HG	1	" "

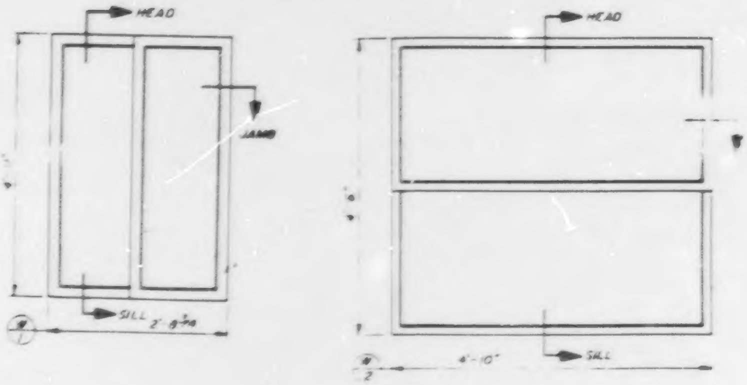
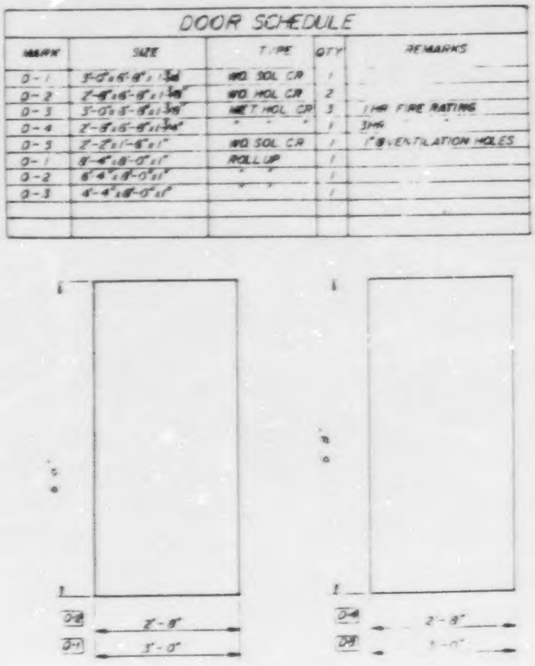


Fig 2-33. Window schedule.

Sometimes the glass size will also be shown in an elevation view of windows. If a window glass contained a number 32/20, this would indicate a glass 32 inches wide by 20 inches high. If only one size is given for a window containing more than one glass, then they are all of the same size. The window schedule will not normally give the size of glass to be used.

Elevation drawings will also show the doors in their correct location, and of what type or style they will be. The symbols for the doors have been covered in work unit 2-8, but as a rule there are three basic types; flush, panel, or combination. The flush door is a plain rectangle, (unless there is a glass opening in it), sometimes with irregular lines to help distinguish it from a panel door. The panel door will be drawn to highlight the panels and/or glass. The swing of the door will not be indicated on an elevation view. The floor plan will show this information.

Schedules or door schedules can also be used in conjunction with the door symbols shown on an elevation drawing. Door schedules can contain the same information as that found on a window schedule. Figure 2-34 shows a typical coded door schedule and its relationship to four flush doors identified as D-1, D-2, D-3, and D-4. Door D-1 is a wooden door with a solid center, D-2 is a wooden door with a hollow center; however, they are both of the same size.



DOOR SCHEDULE

MARK	SIZE	TYPE	QTY	REMARKS
D-1	3'-0"x6'-8"x1 3/4"	WD SOL CR	1	
D-2	2'-8"x6'-8"x1 3/8"	WD HOL CR	2	
D-3	3'-0"x6'-8"x1 3/4"	MET HOL CR	3	1 HR FIRE RATING
D-4	2'-8"x6'-8"x1 3/4"	" " "	1	3HR " "
D-5	2'-2"x1'-6"x1"	WD SOL CR	1	1" ⌀ VENTILATION HOLES
D-1	8'-4"x8'-0"x1"	ROLL UP	1	
D-2	6'-4"x8'-0"x1"	" "	1	
D-3	4'-4"x8'-0"x1"	" "	1	

Fig 2-34. Door schedule.

If glass is to be used in the door, the same numerical system will be used as the one used in the windows. A glass panel in either a flush or panel door which measures 10 inches in width by 18 inches in length would be indicated by the numerical symbol 10/18 on the glass panel.

Miscellaneous openings. There may be many other openings shown on an elevation view. These are usually ventilation openings used to ventilate the foundation or attic. They will be drawn to resemble their final appearance and, hence, are self-explanatory. Figure 2-35 shows an example of an attic louver used to ventilate attic space.

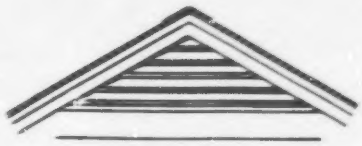


Fig 2-35. Typical roof ventilation louver.

Exterior finish. On the elevation views of a building, the exterior finish will be shown by using various material symbols and notations. Outside wall siding can be of various types of materials such as grooved plywood; shingles of wood, asphalt, or asbestos cement; or any size wood siding. The outside finish can also be made of brick, stone, or concrete block. A combinaton of any of the previously mentioned materials could also be used. Since many of the material symbols closely resemble each other, it is important to read the architect's notes for the exterior finish materials used. Figure 2-36 shows an example of a combination of exterior finish materials used on a single house. The front elevation shows V-Groove Siding over Cedar Shingles. Even if the builder could not understand the material symbols, he would not have any problems determining the materials used on the exterior of the house because of the architect's notation.

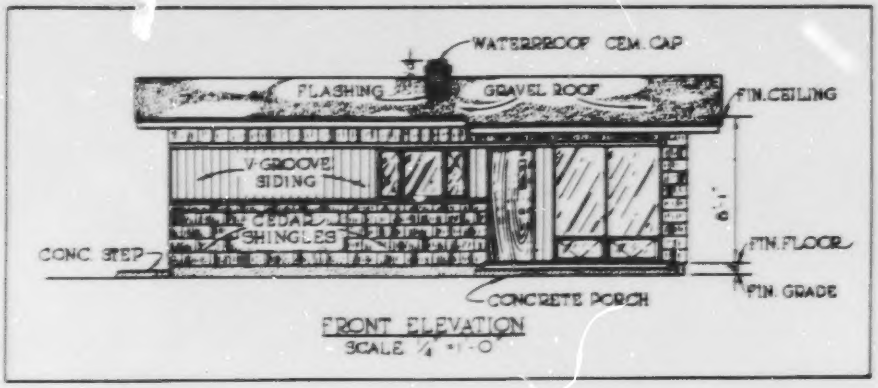
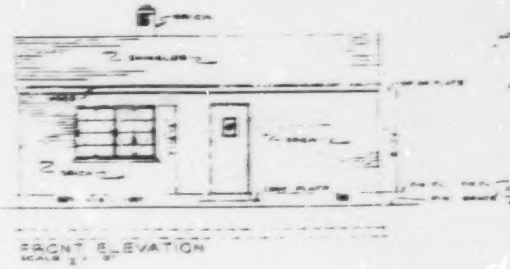
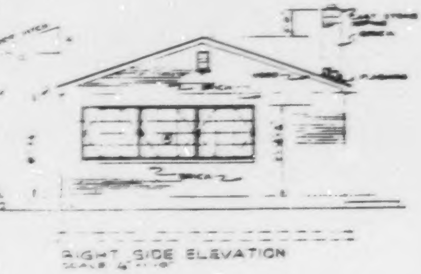
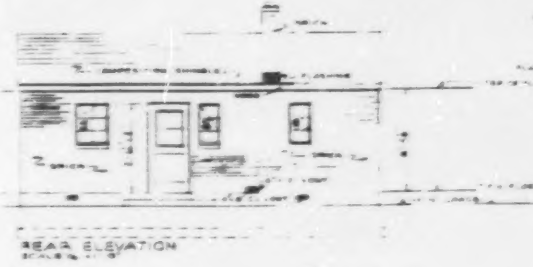

WATERPROOF CEM. CAP
FLASHING
GRAVEL ROOF
FIN. CEILING
V-GROOVE SIDING
CEDAR SHINGLES
CONC. STEP
FIN. FLOOR
FIN. GRADE
CONCRETE PORCH
FRONT ELEVATION
SCALE 1/4"=1'-0"

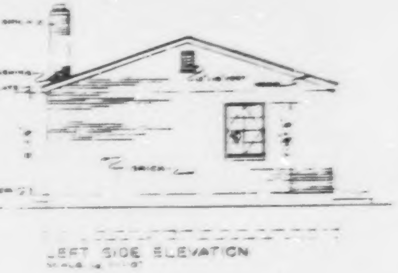
Fig 2-36. Typical exterior finish found on elevation view.

EXERCISE: Answer the following questions about the elevation views below. Check your answers with the answers given at the end of the study unit.


BRICK
SHINGLES
BRICK
BRICK
FRONT ELEVATION


BRICK
FLASHING
BRICK
RIGHT SIDE ELEVATION


BRICK
FLASHING
BRICK
BRICK
REAR ELEVATION


BRICK
FLASHING
BRICK
LEFT SIDE ELEVATION

1. What type of roof is used?

2. What type of material is used to finish the roof?

3. What is the slope of the roof?

4. What is used to provide ventilation in the space under the roof?

5. What type window is used on the left side elevation view?

6. The windows in the rear elevation view are hinged on what side?

7. What kind of door is used at the front entrance?

8. What type of door is shown in the rear elevation view?

9. What material is used on the outside finish of the house?

10. What provides ventilation to the space under the house?

11. Where is metal flashing indicated?

12. What kind of material is used for the top of the chimney?

SUMMARY REVIEW

In the preceding work units you have become acquainted with the use of plot plans, foundation plans, floor plans, and elevation drawings to prepare yourself for the job of reading blueprints before the actual building execution. You can now identify the finish grade or any object on a plot plan. You can identify the two types of foundation plans as wall and column foundations. You can recognize the symbols and abbreviations used on a floor plan. From these you can determine the size, shape, and relationship of any room or auxiliary space on a floor plan. You can determine the number of stories in a building by examining a set of floor plans. Also, you are now able to read the symbols and abbreviations used on elevation drawings; from these drawings you can identify the type and slope of the roof to be used, the type of doors windows, and material for the exterior finish that are to be used.

Answers to Study Unit #2 Exercises

Work Unit 2-1.

1. 114.6'
2. 113.4'
3. 115.3'

Work Unit 2-2.

1. 28'-6"
2. 10'-0"
3. 43'-0"
4. 120'-0"
5. 3'-0"
6. 19'-0"

Work Unit 2-3.

1. labor.
2. Wood
3. column

Work Unit 2-4.

1. wall thickness.
2. Wall
3. Wall

Work Unit 2-5.

1. frame wall
2. Common brick
3. Outswinging casement window
4. Single, opening in
5. double-acting single door.
6. Stairs, 17 risers up

Work Unit 2-6.

1. Apartment
2. Bathtub
3. Concrete
4. Firebrick
5. On Center
6. Plate
7. Roof
8. Sheathing
9. Threshold
10. Water Closet

Work Unit 2-7.

1. Two, (2)
2. Three, (3)
3. 9' x 9'
4. Five, (5)
5. 13'-6" x 15'-3"
6. Thirteen, (13)
7. Right side
8. Broom closet
9. Two, (2)
10. That a basement exists.

Work Unit 2-8.

1. wood panel
2. Brick
3. Glass
4. Wire mesh
5. double hung
6. Outswinging casement
7. horizontal sliding window
8. flush door.

Work Unit 2-9.

1. East
2. Glass
3. Corner
4. North
5. Foundation
6. Window
7. Sheet
8. Long
9. Terra Cotta
10. Elevation

Work Unit 2-10.

1. Gable
2. Shingles
3. 4 in 12
4. Attic louver
5. Casement
6. Right
7. Flush with glass panel
8. Panel with glass
9. Brick
10. 4" x 8" cast iron vent
11. Around the chimney base.
12. Cast stone coping

STUDY UNIT 3

STRUCTURAL INFORMATION

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL BE ABLE TO DETERMINE DIMENSIONS FROM DRAWINGS BY USING AN ARCHITECT'S SCALE. YOU WILL BE ABLE TO LOCATE AND READ DIFFERENT TYPES OF DETAIL DRAWINGS AND FRAMING PLANS. YOU WILL BE ABLE TO IDENTIFY THE TYPES OF FRAME CONSTRUCTION.

A building project may be divided broadly into two major phases, the design phase and the construction phase. First, the architect conceives the building in his mind and sets his concept down on paper in the form of presentation drawings. Next the architect and the engineer, working together, decide upon the materials to be used and the construction methods to be followed. The engineer determines the loads which the supporting (structural) members will carry and the strength the members must have to bear the loads. He also designs the mechanical systems of the structure. The end result of all this is the preparation of architectural and engineering design sketches. The purpose of these design sketches is to guide the draftsmen in the preparation of the construction drawings. These construction drawings, plus the building specifications, are the chief sources of information for the builders responsible for the actual construction work. Most of the structural information needed by the builder actually comes from the different sectional views, detail drawings, and framing plans along with a set of construction prints. This study unit will concentrate on guiding you to find all the structural information on these plans, drawings, and details.

Section I. SCALE AND DIMENSION

To manufacture an object in accordance with a designer's specifications, a builder or craftsman needs more information than that furnished by the scale drawings of its slope. The systematic description of shape must be accompanied by a systematic description of size. Height, width, and length of the object; size and location of its features; plus other important numerical details must be clearly stated. The system of lines, symbols, numerals, and dimensional notes furnishing this information is called dimensioning. Dimensions are numerical values, expressed in appropriate units of a measure, that define the different parts of an object and establish its location.

The purpose of dimensioning is to give workmen on the job sufficient size data to enable them to proceed as easily as possible with the construction. You should not have to seek additional information by scaling the drawing or performing calculations; however, there may be times when it is necessary. Measuring dimensions on a print is called scaling. Due to possible distortion of the print, scaling should be avoided as much as possible. When scaling is essential, however, be sure to check for accuracy by applying the scale you are using to one or more of the important dimensions normally shown on a print. The letters NTS on a set of drawings indicate that they are, "NOT TO SCALE"; therefore, do not try to scale the drawing.

Work Unit 3-1. PRINT SCALE

IDENTIFY THE SCALE USED ON ANY CONSTRUCTION PRINT.

All construction prints found on the job are copies of an architect's plans and drawings, drawn to a scale.

Any map of the local area is an example of a drawing made to scale. All maps have been drawn to scale using some measure other than the original, such as miles per inch. When this is reproduced, one inch on the map will represent one mile on land; therefore, ten inches on the map is really ten miles.

Every line on a drawing will be reduced to the same amount of its true length so that all lines on the print are in exact relationship to each other. The scale usually found on construction prints is 1/4" = 1'-0". Many detailed drawings that require a larger amount of detail of the object will usually be on a scale of 1 1/2" = 1'-0" or larger. Figure 3-1 shows a first floor plan drawn to a scale of 1/4" = 1'-0"; however, the plan has been reduced to fit the page and therefore is no longer to scale. The builder must be very careful to look for any notes that have been added to a drawing.

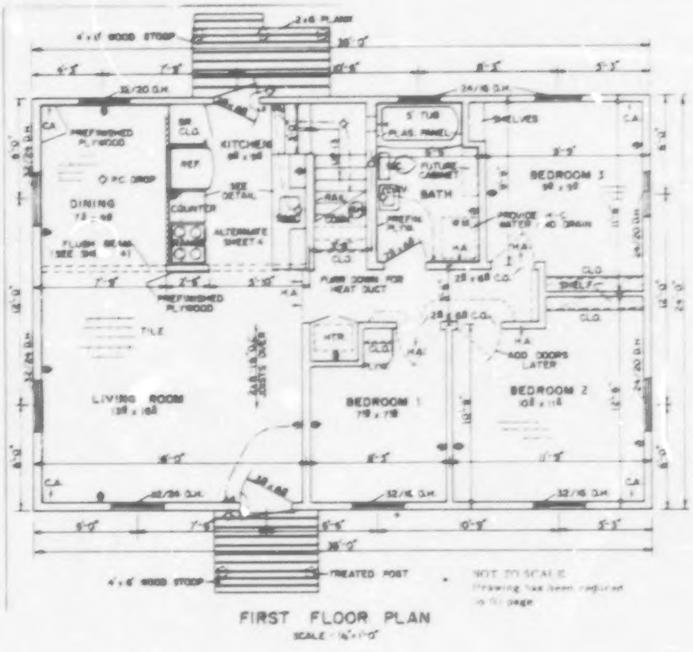

4'x6' WOOD STOOP
2x6 PLANK
36'-0"
CA
PREFINISHED PLYWOOD
DINING
KITCHEN
REF.
COUNTER
ALTERNATE SHEET 4
5' TUB
PLAS. PANEL
SHELVES
FUTURE CABINET
BATH
BEDROOM 3
PROVIDE H-C WATER & DRAIN
SHELF
CLO.
PREFINISHED PLYWOOD
TILE
HTR.
CLO.
LIVING ROOM
BEDROOM 1
BEDROOM 2
ADD DOORS LATER
TREATED POST
4'x6' WOOD STOOP
NOT TO SCALE
Drawing has been reduced to fit page
FIRST FLOOR PLAN
SCALE 1/4"=1'-0"

Fig 3-1. Typical floor plan scale.

On most military drawings the scale block (in the title block) will indicate the scale on the drawing either as a ratio (for example: 1/4 or 1:4 meaning 1 inch on the drawing equals 4 inches on the object, or 12" = 1" meaning 12 inches on the drawing equals 1 inch on the object) or as a graphic scale as shown in figure 3-2. If the same scale is not used on all parts of a drawing, the scale block may be marked "as noted" or left blank, and the scale noted underneath each part of the drawing. If graphic scales are used, several scales may be shown with numbers (fig 3-2) and the appropriate scale number noted alongside each part of the drawing. When reading drawings, always follow the dimensions specified on the drawing first, and use the scale on the drawing where no dimension is given. Because graphic scales are placed in or near the title block of the drawing, their relative lengths to the scales of the drawing are not affected if the drawing is reproduced on reduced or enlarged prints. Do not measure directly on a print unless there is no other means of obtaining the dimensions. Usually during the copying process the print will shrink, or the print may have been reduced for ease of handling.

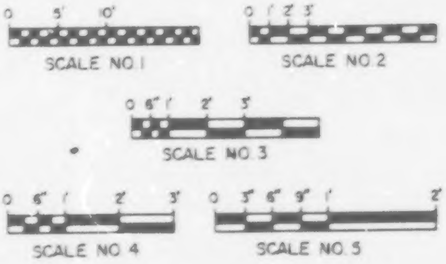
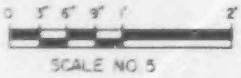

0 5' 10'
SCALE NO.1
0 1' 2' 3'
SCALE NO.2
0 6" 1' 2' 3'
SCALE NO.3
0 6" 1' 2' 3'
SCALE NO.4
0 3" 6" 9" 1' 2'
SCALE NO.5

Fig 3-2. Graphic scales.

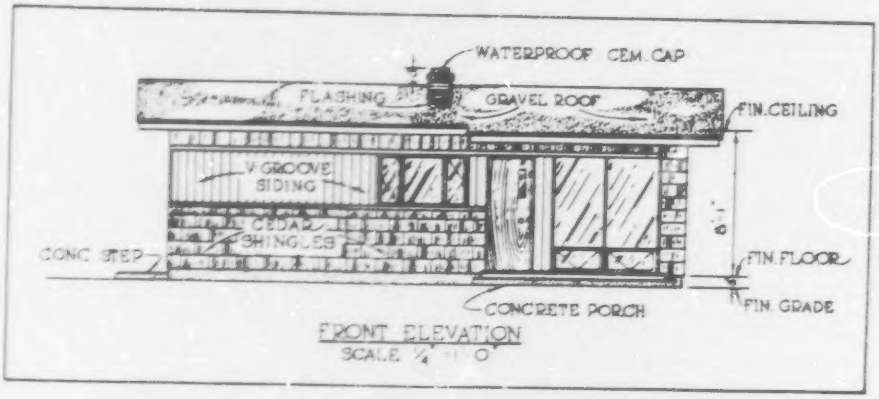
EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. A scale of 3/4" = 1'-0" means that 3/4 inches on the drawing represents ____________________ on the object.

2. The illustration below is a ____________________________ scale.


0
3"
6"
9"
1'
2'
SCALE NO 5

3. The elevation below was drawn to what scale? ________________________


WATERPROOF CEM. CAP
FLASHING
GRAVEL ROOF
FIN. CEILING
V GROOVE SIDING
CEDAR SHINGLES
CONC STEP
8'-1"
FIN. FLOOR
CONCRETE PORCH
FIN. GRADE
FRONT ELEVATION
SCALE 1/4" = 1'-0"

Work Unit 3-2. THE ARCHITECT'S SCALE

IDENTIFY, USING AN ILLUSTRATION OF AN ARCHITECT'S SCALES, THE UNKNOWN DIMENSION BETWEEN TWO POINTS.

Construction prints should be measured only as a last resort. However, if the dimension can not be obtained by other means, then the builder may have to measure the drawing to the needed dimension. The best tool to use in this case would be the architect's scale.

The architect's scale. An architect's scale is very similar to a ruler, except that it has six ruled edges with a total of ten different scales, plus one edge that is identical to the twelve-inch ruler with which you are familiar. Figure 3-3 shows a triangular architect's scale.

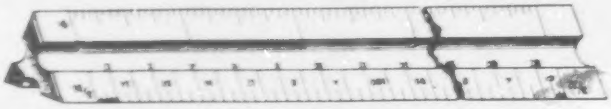


Fig 3-3. Triangular architect's scale.

One of the three scales shown in figure 3-3 is labeled 3/16 which means that it is used to make a drawing at a scale of 3/16" = 1'-0". One foot, at this scale, will be equal to the length of 3/16 of an inch in the drawing.

The following is a list of scales normally found on an architect's scale. Each of the scales listed will be found on an architect's scale, but their location may be different depending upon the manufacture of the scale. Also, each of the scales used in the drawing has its own ratio by which the actual size of the object in the drawing is determined; the ratio is given in parentheses.

Scale label	Scale	Ratio
3"	3" = 1' - 0"	1/4 size
1 1/2"	1 1/2" = 1' - 0"	1/8 size
1"	1" = 1' - 0"	1/12 size
3/4"	3/4" = 1' - 0"	1/16 size
1/2"	1/2" = 1' - 0"	1/24 size
3/8"	3/8" = 1' - 0"	1/32 size
1/4"	1/4" = 1' - 0"	1/48 size
1/8"	1/8" = 1' - 0"	1/64 size
3/16"	3/16" = 1' - 0"	1/96 size
3/32"	3/32" = 1' - 0"	1/128 size

Usually two scales that can be subdivided into each other will be found on the same edge. The scales will normally be grouped as follows; 3 and 1 1/2 scale, 1 and 1/2 scale, 1/4 and 1/8 scale, 3/4 and 3/8 scale, 3/16 and 3/32 scale, and the 16 scale or full scale on an edge by itself.

Reading the architect's scale. The scale is one foot long with an additional space on either end so that the units can be read in parts of a foot such as inches or a fraction of an inch. Figure 3-4 shows one edge of an architect's scale which has two scales. The 1" scale is read from right to left starting with the line marked "0" near the right end of the scale. From the "0" you can read 10 spaces which represents a distance of 10 feet to scale. The 1/2" scale is read from left to right starting at the line marked "0" near the left end of the scale. From the "0" you can read 20 spaces which would represent a distance of 20 feet to scale. You must pay particular attention that the correct numbers are used with the scale. The numbers used with the 1/2" scale are in a row near the edge of the scale. The 1" scale numbers are farther from the edge. The lines for the units have been extended so that you can tell the difference between the two scales.

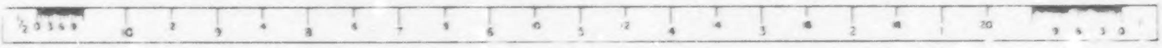


Fig 3-4. Typical 1" and 1/2" scales.

Measurements less than one foot can be read by using the space outside the line marked "0". These units are divided into parts representing one inch or fractions of an inch. The scale is placed so that when the distance is not an even number of feet, the amount in inches can be read directly from the subdivided units of the scale. Figure 3-5 shows four examples of how dimensions can be found using four different scales. First the scale used on the drawing must be determined; then that scale on the architect's scale is used to measure the missing dimension. Not all scales are subdivided into the same amount of units; therefore, care must be taken to determine what each unit represents. The 3" scale is subdivided into 96 units, each one represents 1/8 of an inch; the 1 1/2" and 1" scales are subdivided into 48 units, each one representing 1/4 inch; the 3/4" and 1/2" scales are subdivided into 24 units, each one representing 1/2 inch; the 3/8", 1/4" and 3/16" scales are subdivided into 12 units, each one representing 1 inch; and the 1/8" and 3/32" scales are subdivided into 6 units, each one representing two inches.

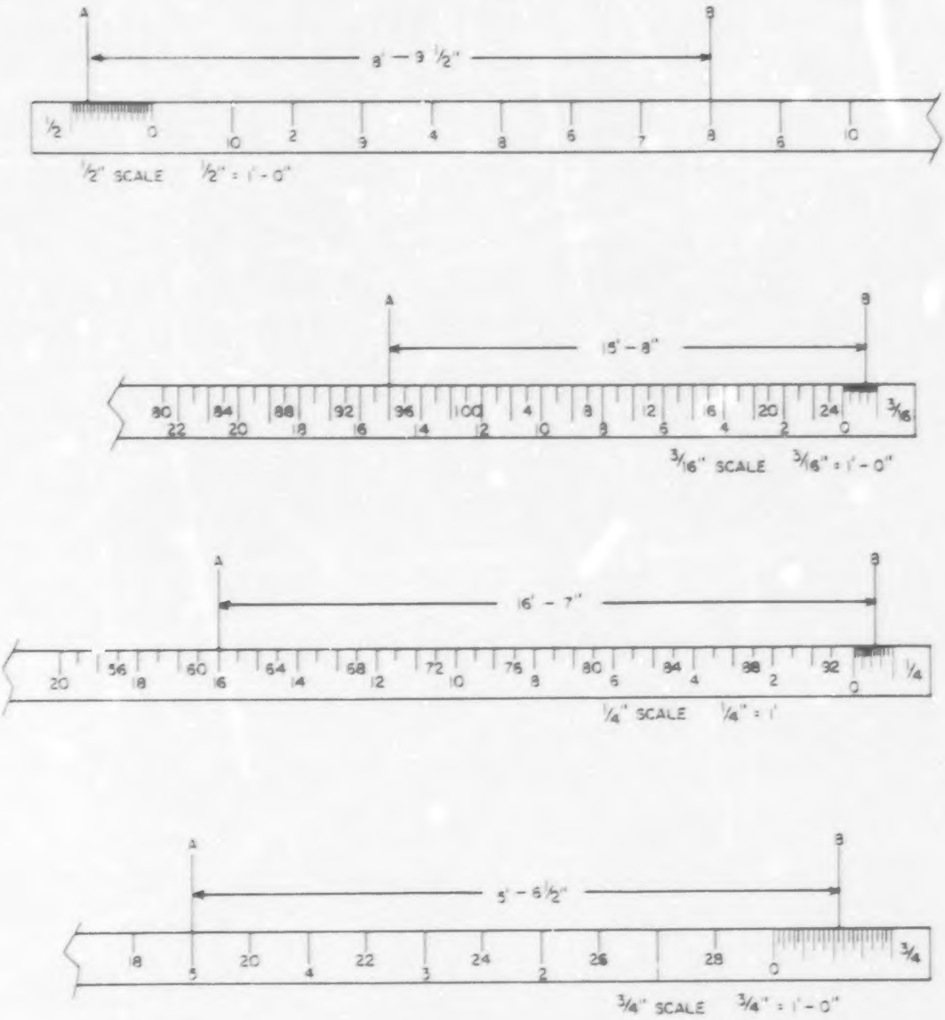
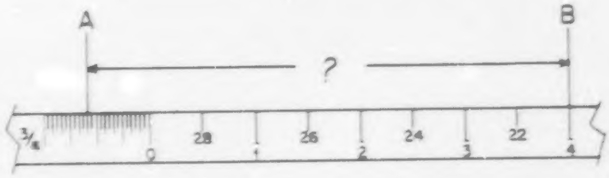

A
B
8' — 9 1/2"
1/2
0
10
2
9
4
8
6
7
8
6
10
1/2" SCALE 1/2" = 1' - 0"
A
B
15' - 8"
80
84
88
92
96
100
4
8
12
16
20
24
3/16
22
20
18
16
14
12
10
8
6
4
2
0
3/16" SCALE 3/16" = 1' - 0"
A
B
16' - 7"
20
56
18
60
16
64
14
68
12
72
10
76
8
80
6
84
4
88
2
92
0
1/4
1/4" SCALE 1/4" = 1'
A
B
5' - 6 1/2"
18
5
20
4
22
3
24
2
26
28
0
3/4
3/4" SCALE 3/4" = 1' - 0"

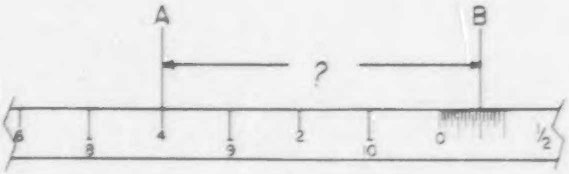
Fig 3-5. Scaling to find missing dimensions.

EXERCISE: Identify the dimensions between points A and B on the illustrations below. Insert your answers in the blank spaces to the right of the numbers. Compare your answers with the answer given at the end of the study unit.

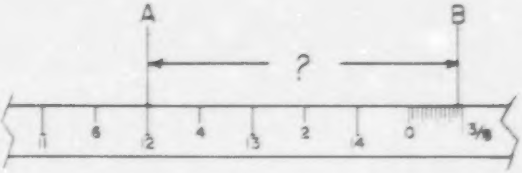
1. ______________________


A
B
?
3/4
0
28
1
26
2
24
3
22
4

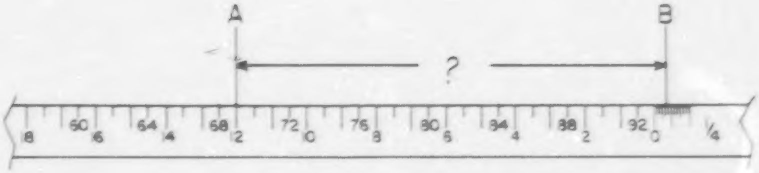
2. ____________________


A
B
?
6
8
4
9
2
10
0
½

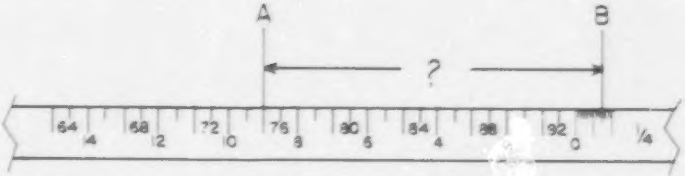
3. ____________________


A
B
?
11
6
12
4
13
2
14
0
3/8

4. ____________________


A
B
?
18
60
16
64
14
68
12
72
10
76
8
80
6
84
4
88
2
92
0
¼

5. ____________________


A
B
?
64
14
68
12
72
10
76
8
80
6
84
4
88
92
0
¼

Work Unit 3-3. CHECKING MISSING DIMENSIONS

CALCULATE, FROM AN ILLUSTRATION, THE MISSING DIMENSIONS.

One of the items you should be most concerned with when reading construction prints is the dimensions. Dimensions on construction drawings will usually be given in feet, inches, and fractions of an inch. Any dimension less than a full foot is written as a simple inch dimension. For example, three inches will be written 3". All dimensions twelve inches or larger will automatically be changed to feet and inches. For example 30 inches becomes 2'-6".

If a dimension is a whole number of feet, it will show zero inches. For example, an even seven feet is shown as 7'-0".

Feet are never shown as fractional feet. They will always be shown in whole numbers. Any fraction of a foot will be changed to inches. For example, five and one-half feet is written as 5'-6" (five feet, six inches).

Any part of an inch will be shown as a fraction. Eight and three-eighths inches will be shown as 8 3/8". Any fraction on a construction print indicates a part of an inch.

Most architects use a standard dimension system; however, some architects may use variations or nonstandard dimensions. For example, instead of writing a nine-foot dimension as 9'-0", they may write it as 9^0, which means 9'-0". Three feet six inches would be written as 3^6. Sometimes an architect will show the finished room size by using this dimension system.

Variations used for showing dimensions. Many architects use a standard system for showing dimensions that are used in conjunction with exterior walls, interior partitions, and openings in walls. However, there are some variations that the builder must be aware of and should keep a close look out for.

Usually the dimensions on construction prints are given to the edge of structural sections. Exterior walls will usually be measured to the outside face of the studs (fig 3-6 D). This is done because the stud walls are built and then the outside sheathing or finish is put on. However, some architects will show dimensions to the outside face of the sheathing (fig 3-6 A).

Brick and concrete walls are always dimensioned to their outside edges (fig 3-6 B and C).

Figure 3-6E shows the way veneer and frame exterior walls are dimensioned. Dimensions of both the outside face of the studs and of the outside edge of the veneer wall are given.

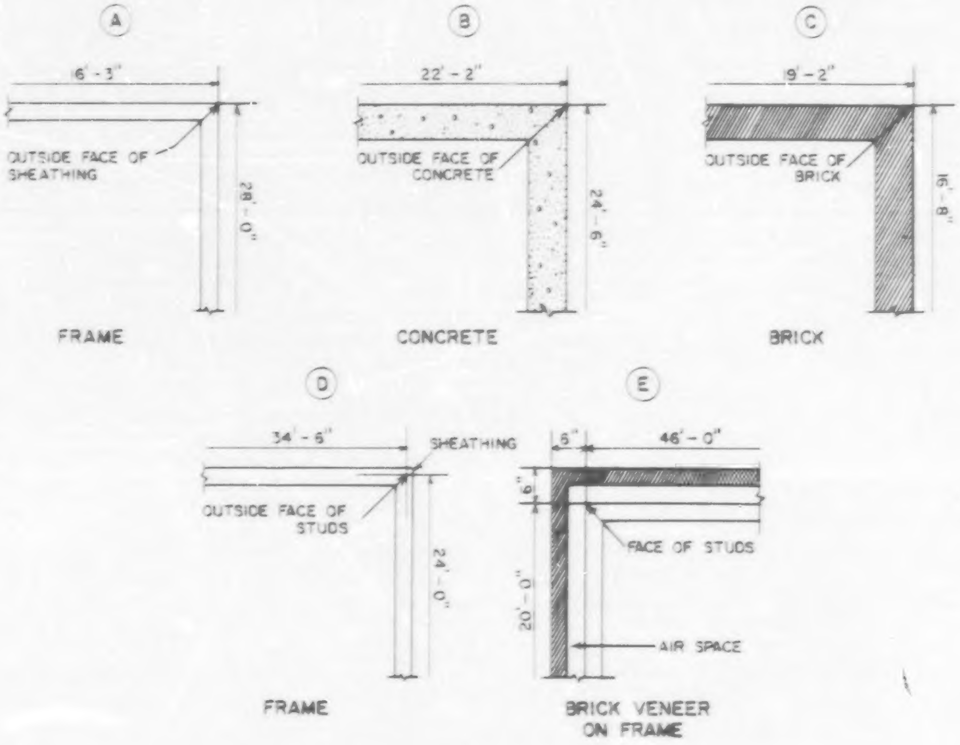

A
16'-3"
OUTSIDE FACE OF SHEATHING
28'-0"
FRAME
B
22'-2"
OUTSIDE FACE OF CONCRETE
24'-6"
CONCRETE
C
19'-2"
OUTSIDE FACE OF BRICK
16'-8"
BRICK
D
34'-6"
SHEATHING
OUTSIDE FACE OF STUDS
24'-0"
FRAME
E
6"
46'-0"
6"
FACE OF STUDS
20'-0"
AIR SPACE
BRICK VENEER ON FRAME

Fig 3-6. Exterior wall dimensions.

Interior wall partitions of brick or concrete will be dimensioned to their outside edges and the wall thickness will also usually be indicated (fig 3-7 A and B). Interior frame wall partitions will normally be dimensioned to the center of the partition (fig 3-7 C). However, some architects may show the dimensions to the outside edge of the wall (fig 3-7 D).

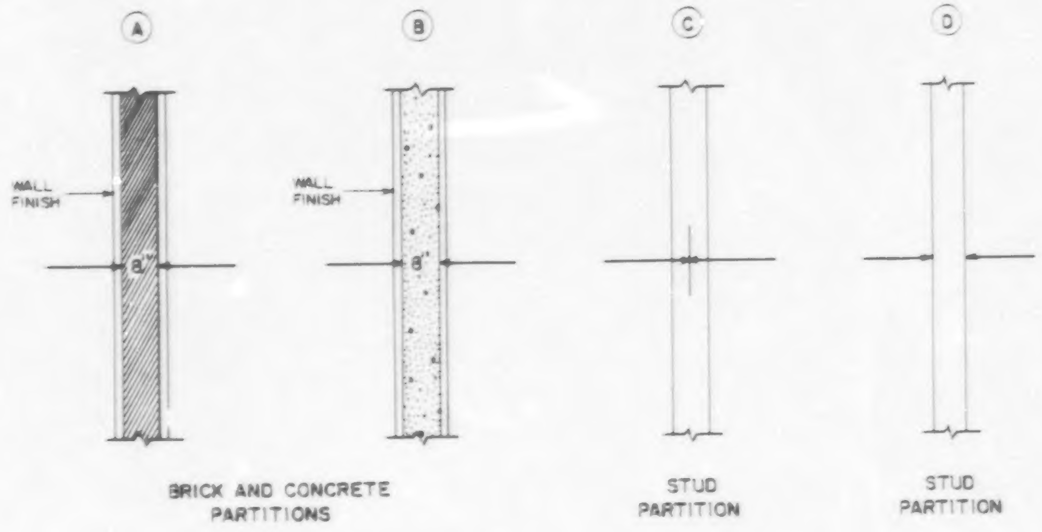

A
B
C
D
WALL FINISH
WALL FINISH
8"
8"
BRICK AND CONCRETE PARTITIONS
STUD PARTITION
STUD PARTITION

Fig 3-7. Interior wall dimensions.

Window and door openings in both frame and veneer exterior walls will be dimensioned to the centers of the openings (fig 3-8). Brick and concrete exterior walls will show dimensions of door and window openings to the edge of the wall (fig 3-8).

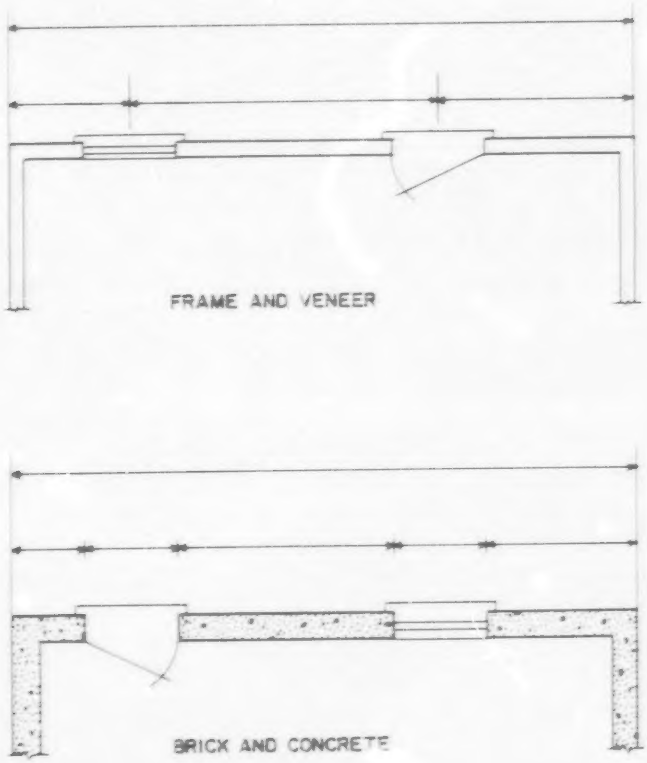

FRAME AND VENEER
BRICK AND CONCRETE

Fig 3-8. Wall opening dimensions.

Locating missing dimensions. Many times when a dimension seems to be missing, it may in fact be located on some other print. Look on all views and/or parts of the prints that are associated with the building or structure. Usually the architect will give a dimension only once to save space.

However, many dimensions can be found by simple arithmetic. Simply by adding and/or subtracting other dimensions on the print, the missing one may be found. Figure 3-9 shows how a missing dimension could be found by using a simple addition and subtraction. By adding the two dimensions given and subtracting them from the overall dimension, the unknown distance between A and B can be found.

3'-0"
+ 4'-4"
7'-4"

16'-0" = 15'-12"
- 7'-4"
8'-8"

The unknown dimension between A and B is 8'-8".

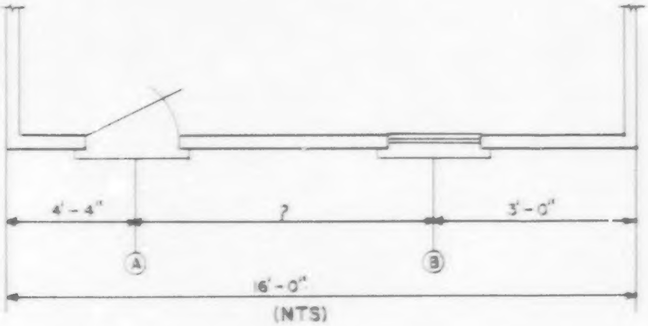
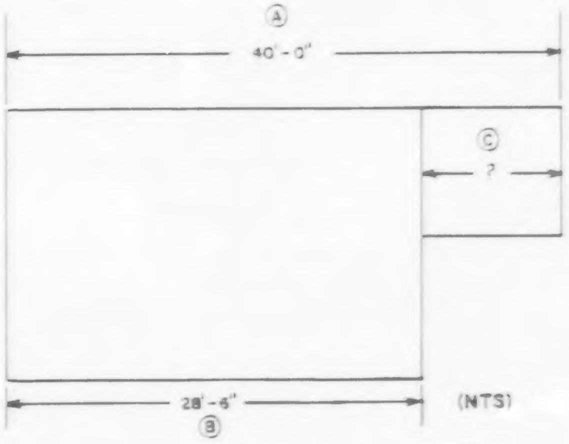


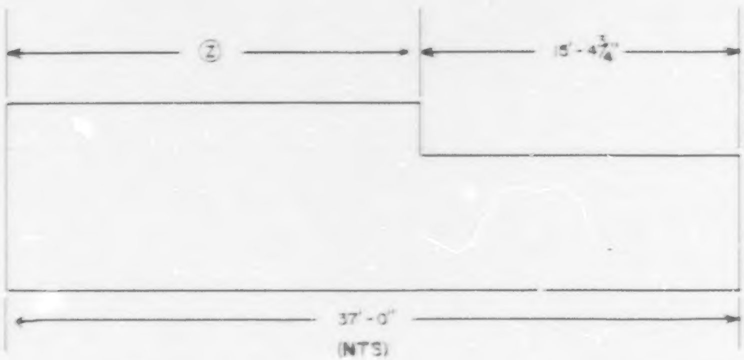
Fig 3-9. Finding missing dimensions.

EXERCISE: Answer the following questions and compare your answers with the answers listed at the end of the study unit.

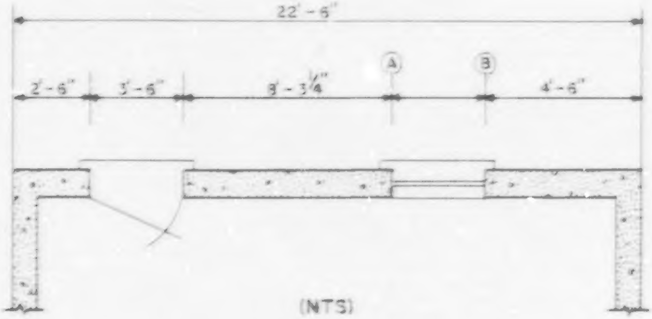
1. What is the unknown dimension of (C) on the illustration below?



2. What is the unknown dimension of (Z) on the illustration below?



3. What is the unknown dimension between A and B on the illustration below?



Section II. DETAIL DRAWINGS

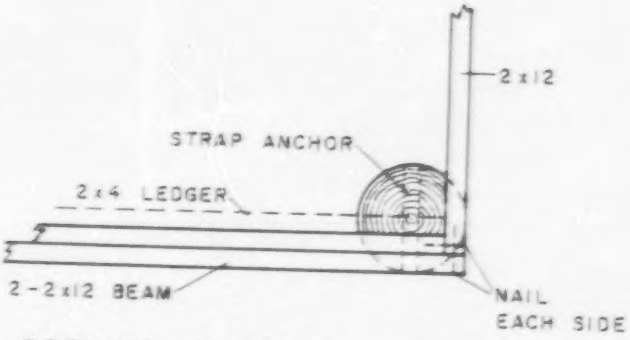
Detail drawings are large scale drawings which show features that do not appear (or appear on too small a scale) on the plans, elevations, and section views. Details do not have a cutting plane indication, but are simply noted by a code. The construction around doors, windows, and eaves is usually shown in detail drawings. Other details which are customarily shown are sills, girder and joist connections.

Work Unit 3-4. DETAIL SCALE

IDENTIFY, FROM A DETAIL DRAWING, THE SCALE USED.

As mentioned earlier, a detail drawing is indicated by a code or the notation "SEE DETAIL" which will be used to call attention to the fact that more information is available about that specific part of the structure (fig 3-10). The detail may be located on the same sheet where the designated part is or it may be elsewhere on another sheet. Many times, several details will be grouped on one sheet; however, when a detail is drawn, it will usually be placed on the same sheet so reference can be made to it without too much inconvenience to the builder.

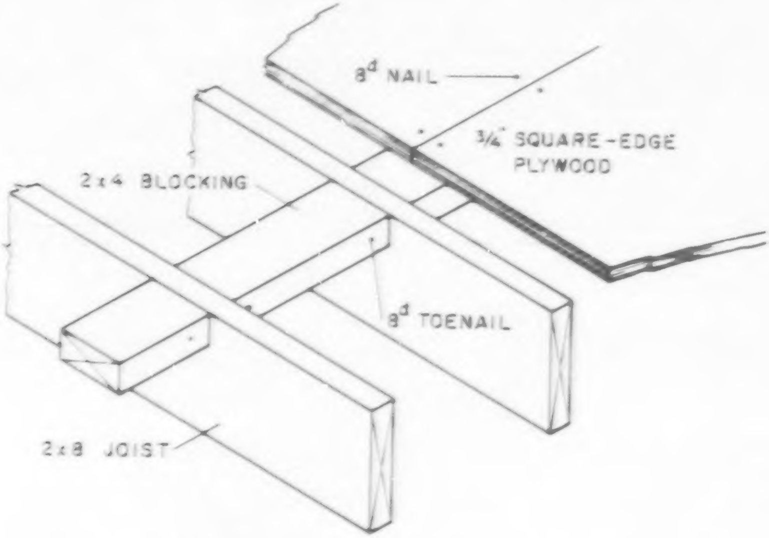
Detail scale. After the detail drawing has been located, the builder must determine the scale used to show the detail. If the details are not too difficult to understand, they may be drawn to the same scale as the plan, elevation, or section views. Details that show structural information will normally be drawn at a larger scale so that the parts can be shown with more clarity. The architect can use any of the scales previously mentioned in work unit 3-2, depending on how large the view must be drawn, so that all the information can be seen clearly.



CORNER FRAMING DETAIL
SCALE - 1" = 1'-0"

Fig 3-10. Detail drawing.

Figure 3-11 shows a detail drawing without any scale indicated. Occasionally an architect will include a detail drawing for informational purposes only; thus the scale is not needed. The architect will indicate this by listing (No scale) under the detail title (fig 3-11).



BLOCKING BETWEEN JOISTS
FOR SQUARE-EDGE PLYWOOD
(NO SCALE)

Fig 3-11. Detail without scale.

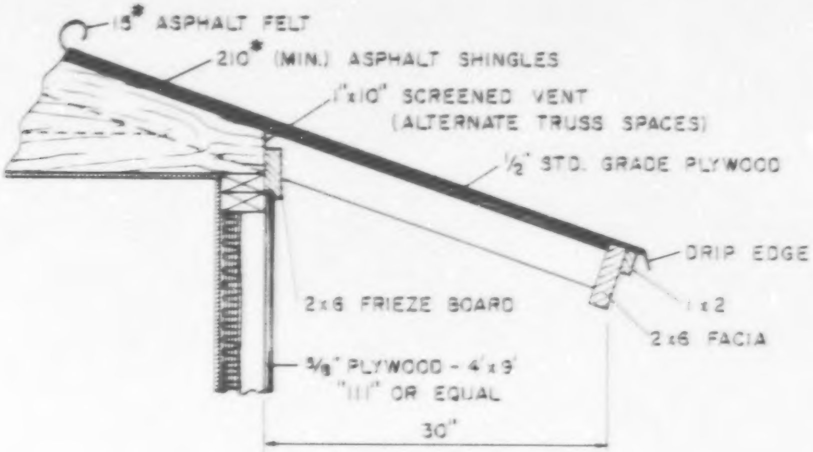
Many times an architect will use preferred scales when drawing details, because the builder using the prints carries a folding ruler that is divided into inches and sixteenths of an inch. Each 1/16 inch on the rule would equal one-inch on a detail drawn to 3/4" = 1'-0" scale. A list of preferred scales and their relationship to the measurements on a folding rule is shown below.

3/4" = 1'-0" scale - 1/16" on rule = 1" on detail
1 1/2" = 1'-0" scale - 1/8" on rule = 1" on detail
3" = 1'-0" scale - 1/4" on rule = 1" on detail
FULL SIZE scale - 1" on rule = 1" on detail

These scales are the preferred ones; however, an architect may and will use any of the scales available to him on an architect's scale. Therefore, a builder when reading a detail drawing must be very careful about the scale used.

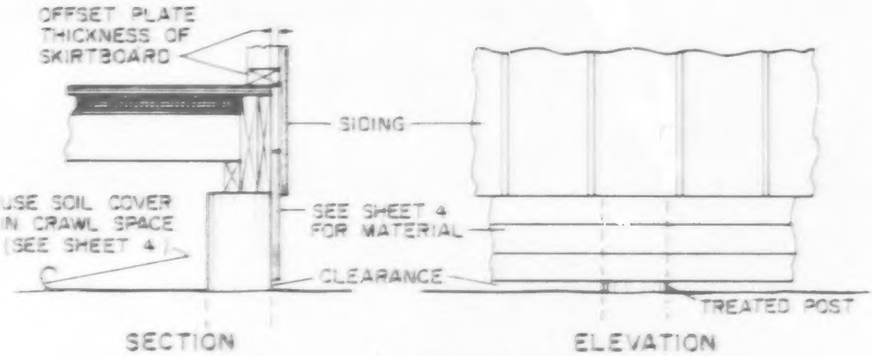
EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. The detail drawing illustration below is drawn to ______________________ scale.


15* ASPHALT FELT
210* (MIN.) ASPHALT SHINGLES
1"x10" SCREENED VENT (ALTERNATE TRUSS SPACES)
½" STD. GRADE PLYWOOD
DRIP EDGE
1x2
2x6 FACIA
2x6 FRIEZE BOARD
⅜" PLYWOOD - 4'x9' "111" OR EQUAL
30"

CORNICE DETAIL
TRUSS
SCALE - 1" = 1' - 0"

2. What scale is used on the detail illustrated below?


OFFSET PLATE THICKNESS OF SKIRTBOARD
SIDING
USE SOIL COVER IN CRAWL SPACE (SEE SHEET 4)
SEE SHEET 4 FOR MATERIAL
CLEARANCE
TREATED POST
SECTION
ELEVATION

ALTERNATE SKIRTBOARD DETAIL
SCALE - ¾" = 1'-0"

Work Unit 3-6. INTERIOR DETAILS

IDENTIFY, FROM AN ILLUSTRATION, ANY INTERIOR DETAIL DRAWINGS.

Interior detail drawings can consist of, but are not limited to, the following items: views of kitchen cabinets and all built-in items, cabinets and closets throughout the building, permanently attached items in the bathroom, interior trim, fireplaces, and stairways.

Most of the items shown in a detail will also be shown on a plan or elevation view elsewhere on the set of prints; however, they do not include enough information for the builder. Therefore, a detail drawing is drawn to give the builder this needed information.

Detail drawings of kitchen. Figure 3-12 shows two detailed elevation views of a typical kitchen. The drawings not only give the measurement of the cabinets, but also show where the sink, range, and refrigator are to be located.

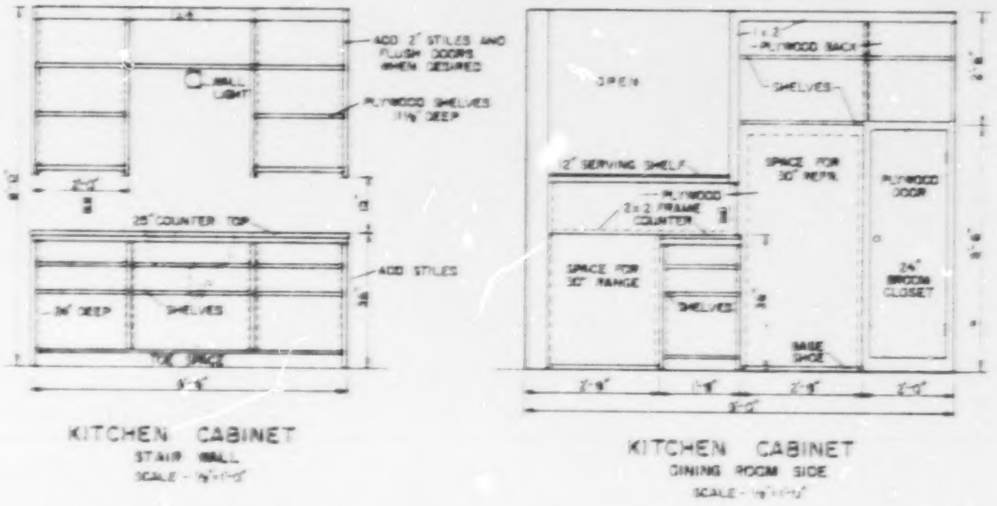

ADD 2" STILES AND FLUSH DOORS WHEN DESIRED
WALL LIGHT
PLYWOOD SHELVES 11⅝" DEEP
2'-0"
25" COUNTER TOP
ADD STILES
36" DEEP
SHELVES
TOE SPACE
KITCHEN CABINET
STAIR WALL
SCALE - ⅛"=1'-0"
1 x 2
PLYWOOD BACK
OPEN
SHELVES
12" SERVING SHELF
SPACE FOR 30" REFR.
PLYWOOD DOOR
PLYWOOD
2 x 2 FRAME COUNTER
SPACE FOR 30" RANGE
SHELVES
24" BROOM CLOSET
BASE SHOE
2'-9"
1'-9"
2'-9"
2'-0"
KITCHEN CABINET
DINING ROOM SIDE
SCALE - ⅛"=1'-0"

Fig 3-12. Kitchen detail drawing.

Detail drawings of closets. Figure 3-13 shows both a front view and a side view of a typical closet (wardrobe). By using the information provided on the detail, the builder would have very little trouble building the closet.

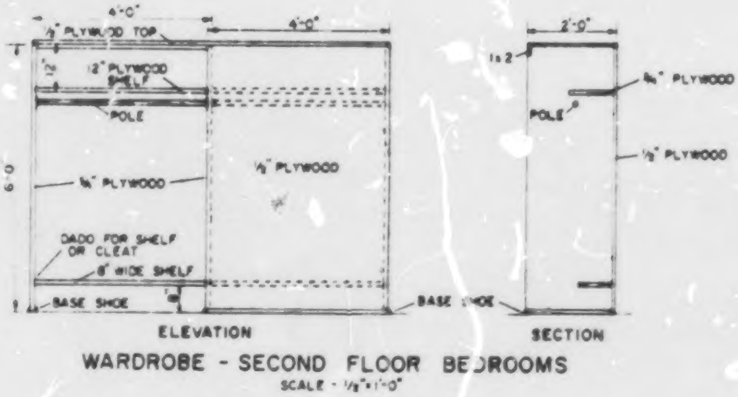

4'-0"
½" PLYWOOD TOP
4'-0"
12" PLYWOOD SHELF
POLE
6'-0"
¾" PLYWOOD
½" PLYWOOD
DADO FOR SHELF OR CLEAT
8" WIDE SHELF
BASE SHOE
BASE SHOE
ELEVATION
2'-0"
1x2
¾" PLYWOOD
POLE
½" PLYWOOD
SECTION
WARDROBE - SECOND FLOOR BEDROOMS
SCALE - ½"=1'-0"

Fig 3-13. Closet detail drawing.

Detail drawings of bathrooms. Figure 3-14 shows a typical bathroom detail drawing. From the detail a builder can determine the exact location of every fixture in the bathroom.

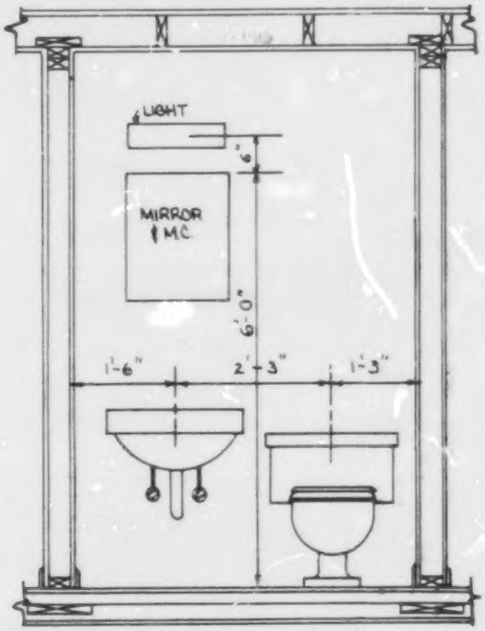

LIGHT
6"
MIRROR
℄ M.C.
6'-0"
1'-6"
2'-3"
1'-3"

Fig 3-14. Bathroom detail drawing.

Detail drawing of interior trim. Figure 3-15 is a typical detail drawing that shows how the window trim must be applied. Figure 3-16 is a detail drawing of how the base molding is applied. Figure 3-17 is a detail drawing of the ceiling molding. None of the details are drawn to scale.

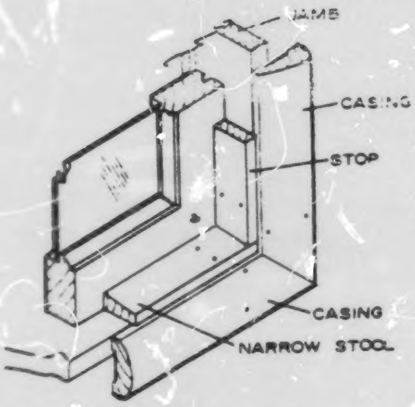

JAMB
CASING
STOP
CASING
NARROW STOOL

Fig 3-15. Detail drawing of window trim.

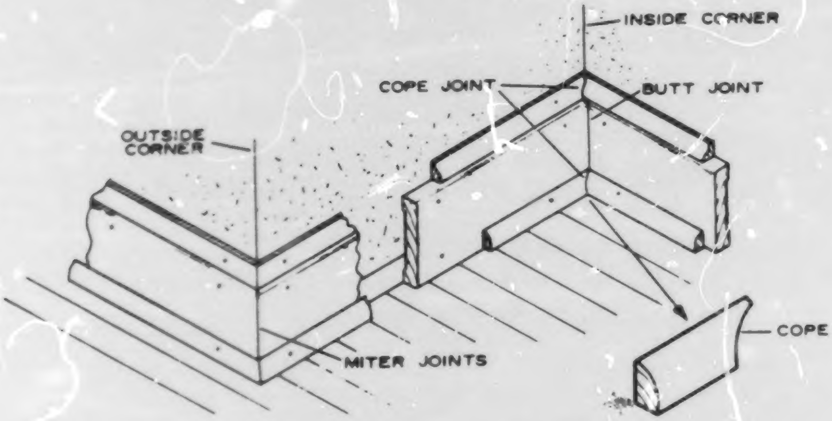

INSIDE CORNER
COPE JOINT
BUTT JOINT
OUTSIDE CORNER
COPE
MITER JOINTS

Fig 3-16. Detail drawing of base molding.

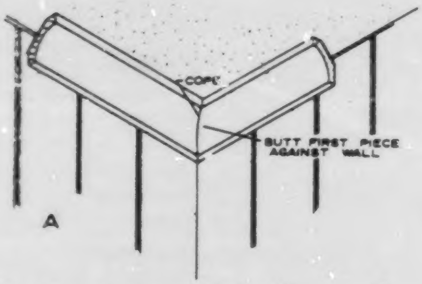

COPE
BUTT FIRST PIECE AGAINST WALL
A

Fig 3-17. Detail drawing of ceiling molding.

Detail drawing of an interior stairway. A typical detail drawing showing a stairway and opening is illustrated in figure 3-18. The detail shown is not to scale; however, from it the builder can obtain a lot of information such as headroom, width of tread, height of riser, and total rise of the stairway that he will use to build the stairway.

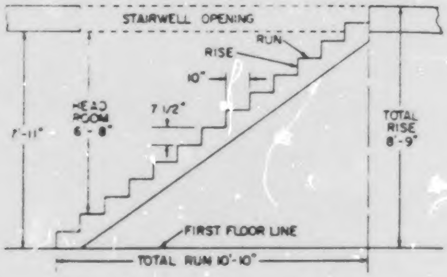

STAIRWELL OPENING
RUN
RISE
10"
HEAD ROOM 6'-8"
7 1/2"
7'-11"
TOTAL RISE 8'-9"
FIRST FLOOR LINE
TOTAL RUN 10'-10"

Fig 3-18. Stairway detail drawing.

Detail drawing of a fireplace. Figure 3-19 shows a typical detail drawing of a masonry fireplace. The view presented is a sectional cut of a fireplace. Usually for a fireplace the complete set of details will consist of a section, plan, and elevation view because of the complexity of the construction.

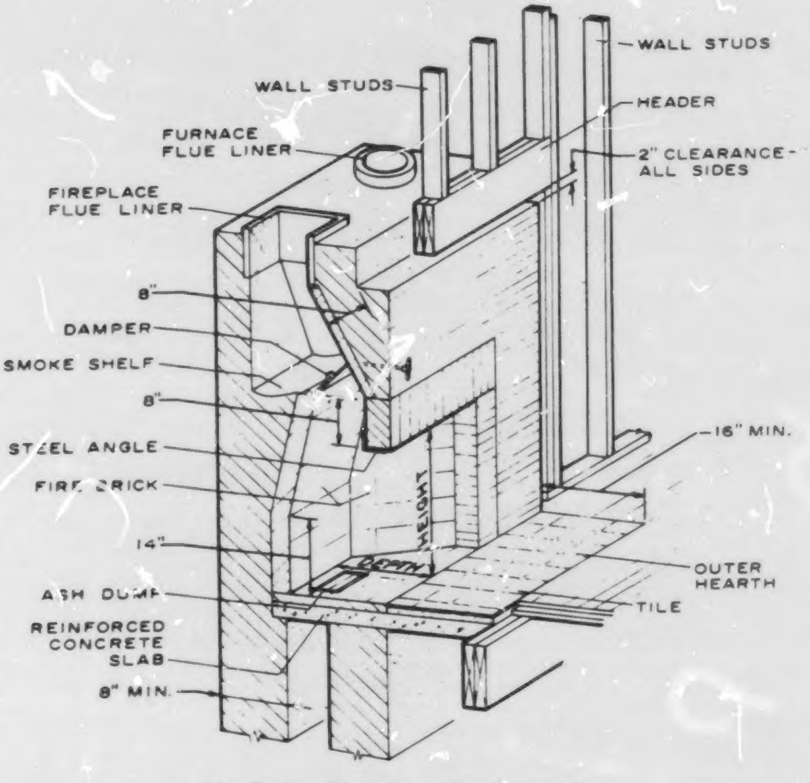
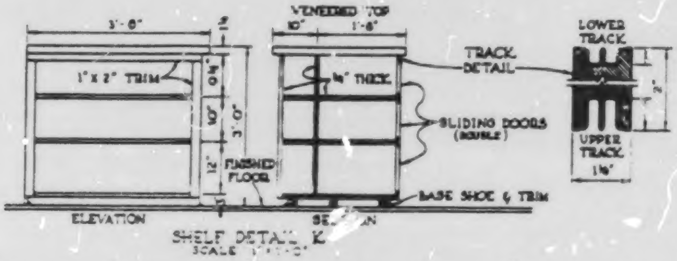

WALL STUDS
WALL STUDS
HEADER
FURNACE FLUE LINER
2" CLEARANCE-ALL SIDES
FIREPLACE FLUE LINER
8"
DAMPER
SMOKE SHELF
8"
STEEL ANGLE
FIRE BRICK
HEIGHT
14"
DEPTH
16" MIN.
OUTER HEARTH
ASH DUMP
TILE
REINFORCED CONCRETE SLAB
8" MIN.

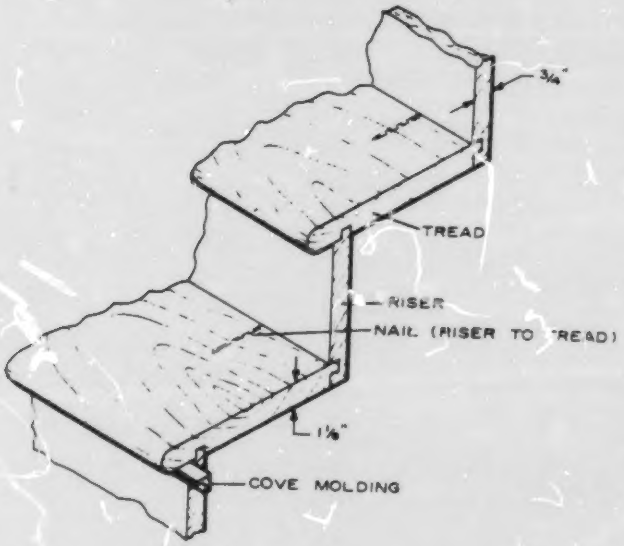
Fig 3-19. Fireplace detail drawing.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. The illustration below is an example of a detail drawing of a ____________________.


3'-6"
VENEERED TOP
10"
1'-6"
LOWER TRACK
TRACK DETAIL
1" X 2" TRIM
¾" THICK
3'-0"
10"
12"
SLIDING DOORS (DOUBLE)
UPPER TRACK
1½"
FINISHED FLOOR
BASE SHOE & TRIM
ELEVATION
SECTION
SHELF DETAIL K
SCALE

2. The illustration below is an example of a ____________________ detail drawing.


¾"
TREAD
RISER
NAIL (RISER TO TREAD)
1⅛"
COVE MOLDING

Work Unit 3-6. EXTERIOR DETAILS

IDENTIFY, FROM AN ILLUSTRATION, ANY EXTERIOR DETAIL DRAWING.

An exterior detail can be drawn of any object when the architect usually feels additional information is needed. Therefore, we will not try to show every type of exterior detail drawing; however, we will show some of the objects that are usually drawn in detail.

Cornice detail. The cornice of a building is the projection of the roof at the eave line which forms a connection between the roof and sidewalls. In gable roofs it is formed on each side of the building, and in hip roofs it is continuous around the perimeter. Figure 3-20 shows a typical cornice detail drawn to 1" = 1'-0" scale.

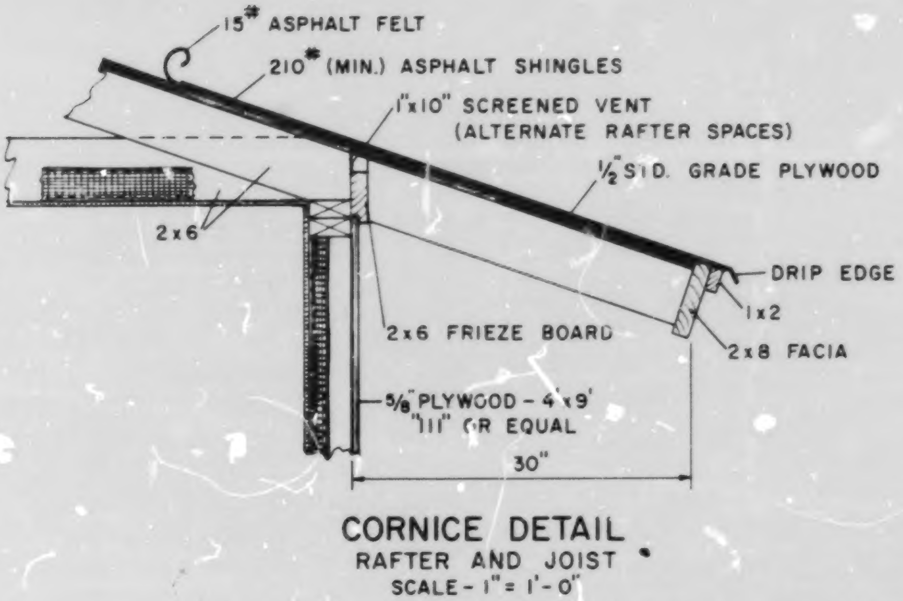

15# ASPHALT FELT
210# (MIN.) ASPHALT SHINGLES
1"x10" SCREENED VENT
(ALTERNATE RAFTER SPACES)
1/2" STD. GRADE PLYWOOD
2x6
DRIP EDGE
1x2
2x6 FRIEZE BOARD
2x8 FACIA
5/8" PLYWOOD - 4'x9'
"111" OR EQUAL
30"
CORNICE DETAIL
RAFTER AND JOIST
SCALE - 1" = 1'-0"

Fig 3-20. Typical cornice detail.

Gable end overhang. The gable end overhang is the extension of a gable roof beyond the end wall of the building. The detail will give the builder information about the types and size of materials and how far the overhang will extend beyond the end wall. Figure 3-21 shows a typical end overhang.

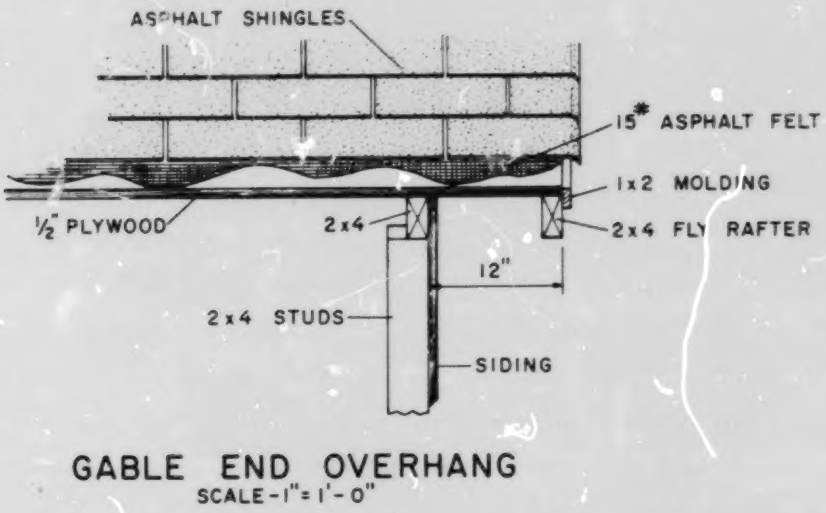

ASPHALT SHINGLES
15# ASPHALT FELT
1x2 MOLDING
1/2" PLYWOOD
2x4
2x4 FLY RAFTER
12"
2x4 STUDS
SIDING
GABLE END OVERHANG
SCALE - 1" = 1'-0"

Fig 3-21. Typical gable end overhang.

Vent pipe openings in roof. Normally all the openings in the roof will be shown in detail. Figure 3-22 shows a typical vent pipe detail.

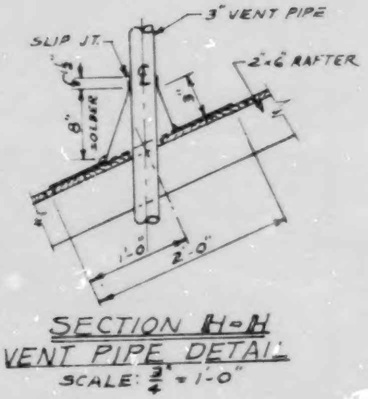

3" VENT PIPE
SLIP JT.
2"×6" RAFTER
3"
8"
SOLDER
3"
1'-0"
2'-0"
SECTION H-H
VENT PIPE DETAIL
SCALE: 3/4" = 1'-0"

Fig 3-22. Vent pipe detail.

Smokejack and chimney details. Openings for smokestacks (pipes, jacks) and chimneys will be shown in detail drawings so that the builder can provide an adequate opening in the roof. Additional information is usually provided which will show the exact size and location of the chimney or smokestack. Figure 3-23 shows a smokestack (jack) detail. Note the similarity between the smokestack shown in figure 3-23 and the vent pipe shown in figure 3-22.

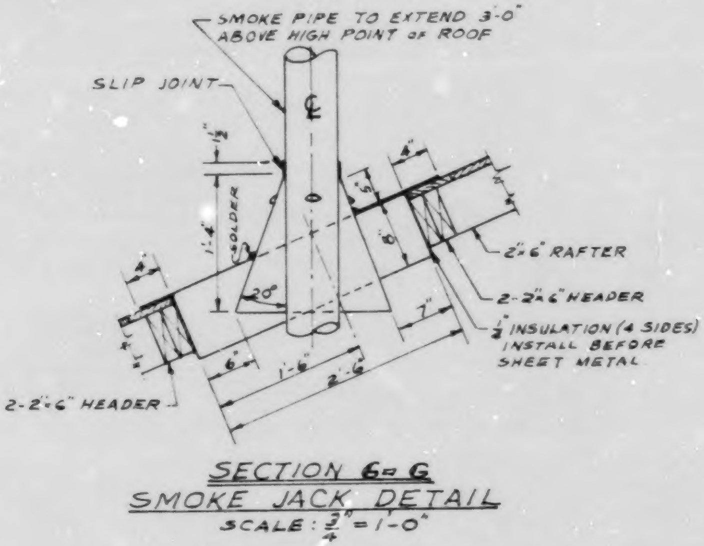

SMOKE PIPE TO EXTEND 3'-0" ABOVE HIGH POINT OF ROOF
SLIP JOINT
1½"
1'-4"
SOLDER
20°
4"
5"
8"
4"
7"
6"
1'-6"
2'-6"
2"×6" RAFTER
2-2"×6" HEADER
½" INSULATION (4 SIDES) INSTALL BEFORE SHEET METAL
2-2"×6" HEADER
SECTION G-G
SMOKE JACK DETAIL
SCALE: 3/4" = 1'-0"

Fig 3-23. Smokestack detail.

Louver and ridge ventilator details. Buildings with louvered or ridge ventilators will usually show details of the vents. Figure 3-24 shows a louver detail. A ridge ventilator detail is shown in figure 3-25.

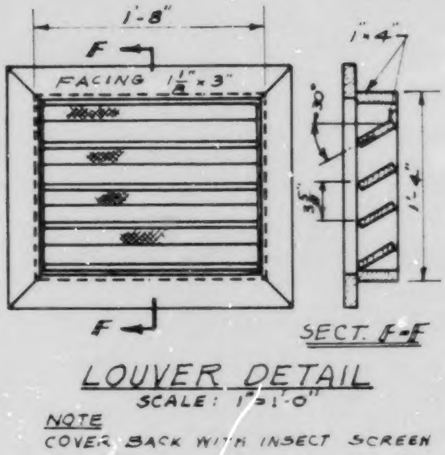

1'-8"
F
FACING 1½"×3"
1×4
30°
3½"
1'-4"
F
SECT. F-F
LOUVER DETAIL
SCALE: 1"=1'-0"
NOTE
COVER BACK WITH INSECT SCREEN

Fig 3-24. Louver detail drawing.

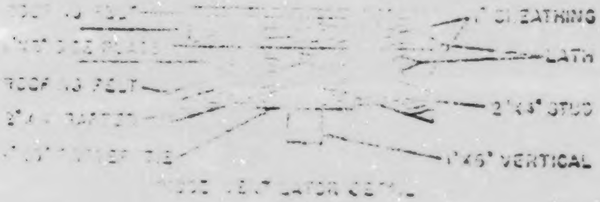

ROOF 15 FELT
2"×6" RAFTER
SHEATHING
LATH
2"×6" STUD
1"×6" VERTICAL

Fig 3-25. Ridge ventilator detail drawing.

Exterior stair/step details. If a building has exterior stairs or steps, the architect will usually draw a detail showing the design and size of the stairs. A typical stair detail is shown in figure 3-26.

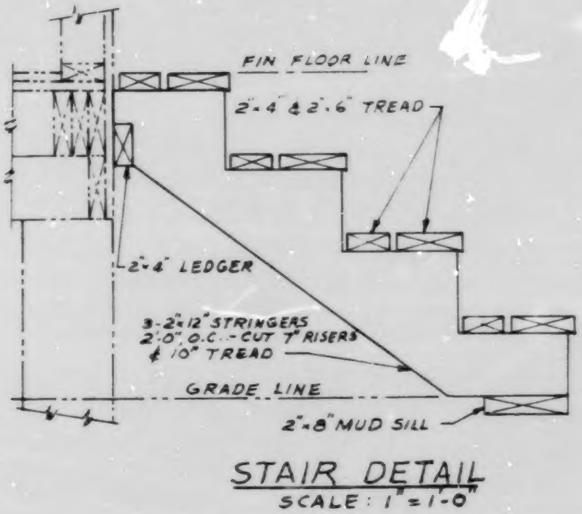

FIN FLOOR LINE
2"×4" & 2"×6" TREAD
2"×4" LEDGER
3-2"×12" STRINGERS
2'-0" O.C.-CUT 7" RISERS
& 10" TREAD
GRADE LINE
2"×8" MUD SILL
STAIR DETAIL
SCALE: 1"=1'-0"

Fig 3-26. Exterior stair detail.

Skirtboard detail drawing. Many buildings that have a post foundation will use skirting to fill in the space between the floor joist and the finished grade. The architect may choose to show a detail of how the skirtboard will be attached. Figure 3-27 shows a skirtboard detail drawing.

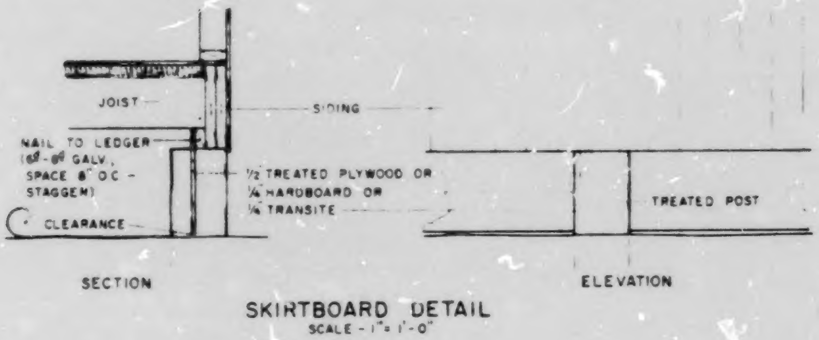
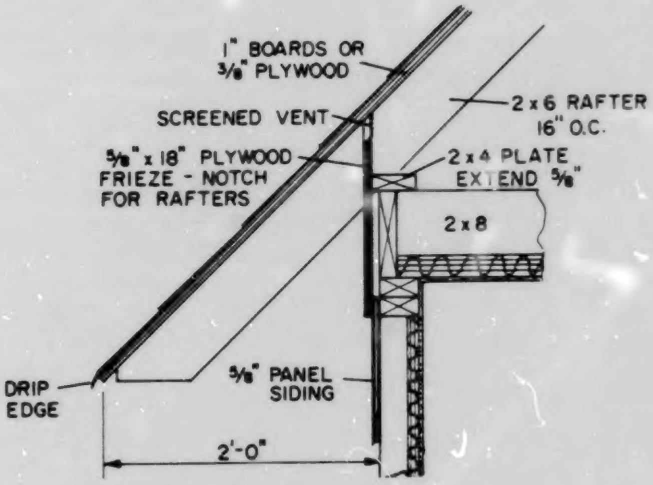

JOIST
SIDING
NAIL TO LEDGER
(6d-8d GALV,
SPACE 8" O.C -
STAGGER)
CLEARANCE
1/2 TREATED PLYWOOD OR
1/4 HARDBOARD OR
1/4 TRANSITE
TREATED POST
SECTION
ELEVATION
SKIRTBOARD DETAIL
SCALE - 1" = 1'-0"

Fig 3-27. Skirtboard detail drawing.

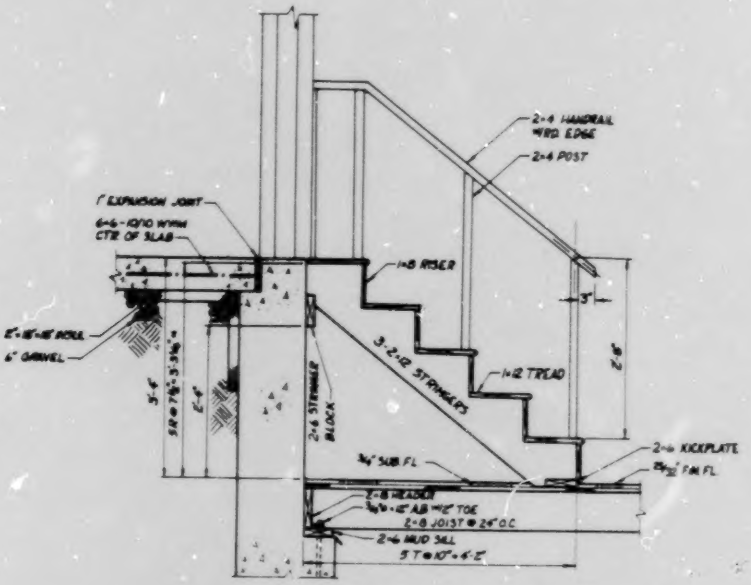
This work unit has shown only a few of the many objects that can be drawn in detail by the architect. He may show by drawing in detail any unusual use of siding, a dormer, an unusual entranceway, or an unusual pattern of laying brick used for ornamental decoration.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. What exterior detail is illustrated by the drawing below?


1" BOARDS OR
3/8" PLYWOOD
SCREENED VENT
5/8" x 18" PLYWOOD
FRIEZE - NOTCH
FOR RAFTERS
2 x 6 RAFTER
16" O.C.
2 x 4 PLATE
EXTEND 5/8"
2 x 8
DRIP
EDGE
5/8" PANEL
SIDING
2'-0"

2. The illustration below is an example of an exterior ________________ detail drawing.


2-4 HANDRAIL
RND EDGE
2-4 POST
EXPANSION JOINT
6-6-10/10 WWM
CTR OF SLAB
1-8 RISER
3"
2'-8"
3-2-12 STRINGERS
1-12 TREAD
2-6 STRINGER
BLOCK
3'-4"
2'-4"
6" GRAVEL
¾" SUB FL
2-6 KICKPLATE
2-8 HEADER
2-8 JOIST @ 24" O.C
2-6 MUD SILL
5 T @ 10" = 4'-2"

Work Unit 3-7. WINDOW AND DOOR DETAILS

IDENTIFY, FROM AN ILLUSTRATION, A WINDOW DETAIL DRAWING.

IDENTIFY, FROM AN ILLUSTRATION, A DOOR DETAIL DRAWING.

Most windows and their frames are millwork items that are usually fully assembled at the factory. Window units, for example, often have the sash fitted, are weatherstripped, the frame assembled, and the exterior casing in place. Standard combination storms and screens or separate units may also be included. Since most windows come fully assembled, most construction prints in the business world will not show window details. However, this is not true on military construction prints. Usually all military construction prints will include detail drawings for every type of window used in the structure.

Details shown on double-hung window. The double-hung window is perhaps the most familiar type of window. It consists of an upper and lower sash that slide vertically in separate grooves in the side jambs or in full-width metal weatherstripping. The top of the window frame is called the head. The sides of the window are called jambs. The bottom is called the sill. Figure 3-28 shows a double-hung window with four (4) details and the location from which the detail is taken. Figure 3-28A shows a cross section view of the head. Figure 3-28B shows a cross section view of the meeting rails. Figure 3-28C shows a cross section view of the side jamb (notice that the jamb section is a plan view, looking down).

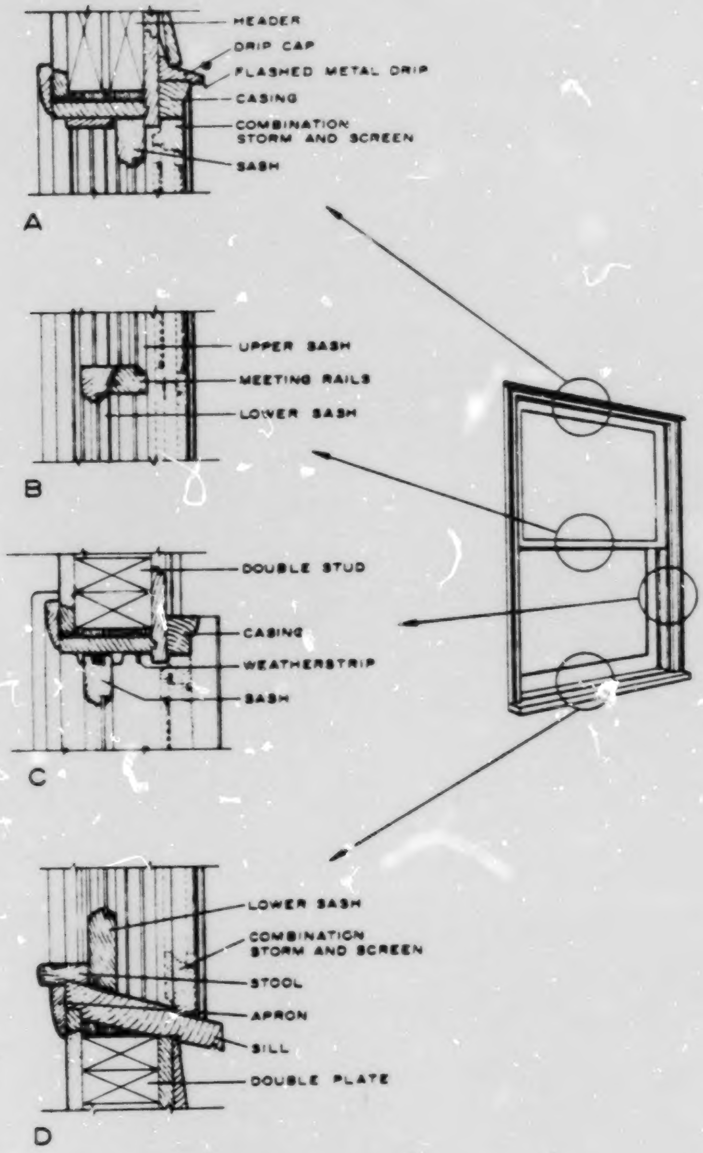

HEADER
DRIP CAP
FLASHED METAL DRIP
CASING
COMBINATION STORM AND SCREEN
SASH
A
UPPER SASH
MEETING RAILS
LOWER SASH
B
DOUBLE STUD
CASING
WEATHERSTRIP
SASH
C
LOWER SASH
COMBINATION STORM AND SCREEN
STOOL
APRON
SILL
DOUBLE PLATE
D

Fig 3-28. Double-hung window details.

Details shown on casement windows. Casement windows consist of side-hinged sash, usually designed to swing outward. Figure 3-29 shows an outswinging casement window with four (4) detail views. View A is a sectional view of the head. View B is a sectional view (plan view, looking down) of the meeting rails. A sectional view of side jamb (plan view, looking down) is shown in view C. View D shows a sectional view of the sill.

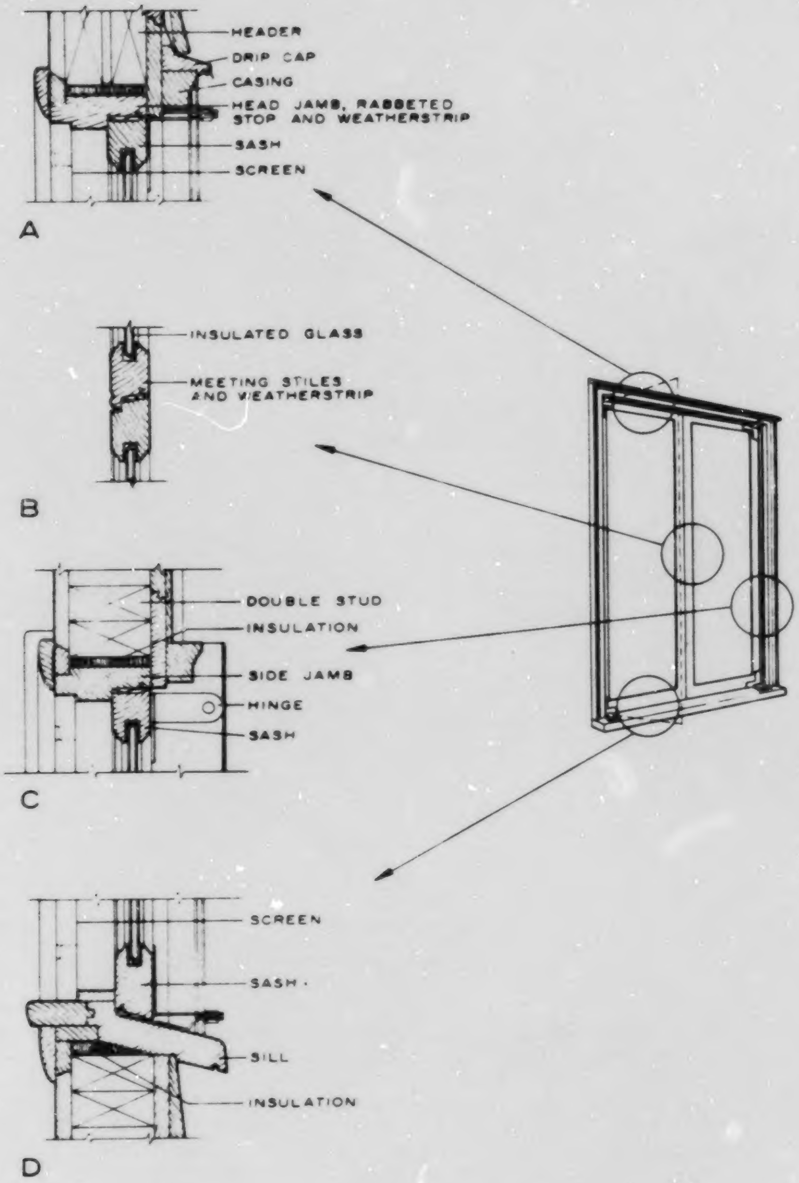

HEADER
DRIP CAP
CASING
HEAD JAMB, RABBETED STOP AND WEATHERSTRIP
SASH
SCREEN
A
INSULATED GLASS
MEETING STILES AND WEATHERSTRIP
B
DOUBLE STUD
INSULATION
SIDE JAMB
HINGE
SASH
C
SCREEN
SASH
SILL
INSULATION
D

Fig 3-29. Casement window detail.

Details shown on stationary windows. Stationary windows used alone or in combination with double-hung or casement windows usually consist of a wood sash with a large single light of insulated glass. A stationary window with two (2) detail views is shown in figure 3-30. View A shows a section view of the head, and view B shows a section view of the sill. Also, shown in figure 3-30 is an illustration of a stationary window used in combination with two double-hung windows.

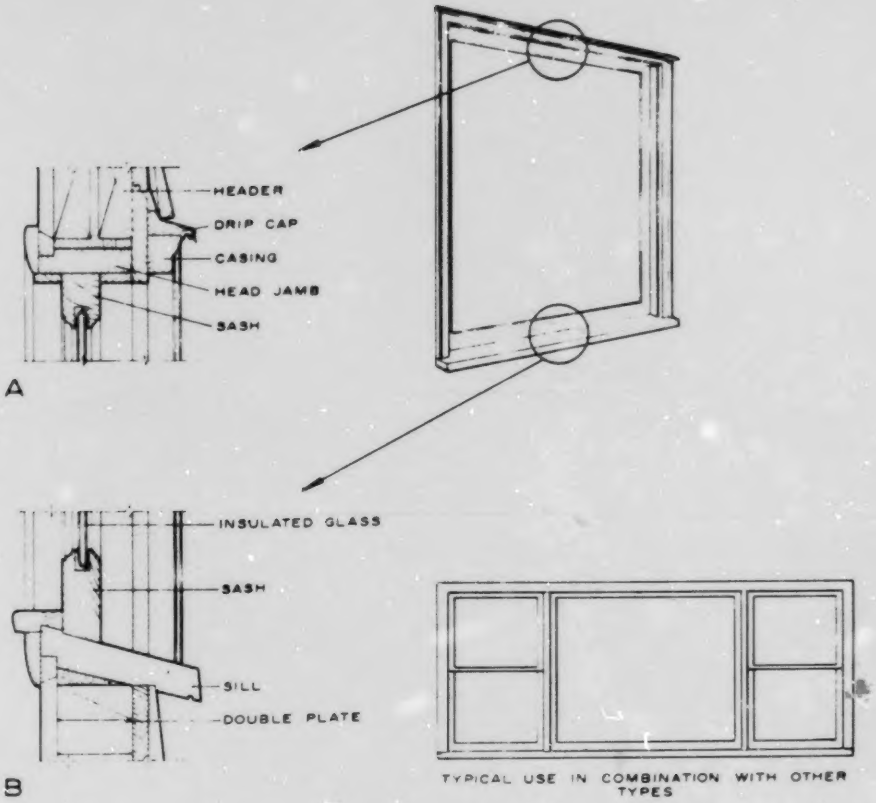

HEADER
DRIP CAP
CASING
HEAD JAMB
SASH
A
INSULATED GLASS
SASH
SILL
DOUBLE PLATE
B
TYPICAL USE IN COMBINATION WITH OTHER TYPES

Fig 3-30. Stationary window details.

Details shown of awning windows. An awning window unit consists of a frame in which one or more operative sashes are installed. The sashes of the awning type window are made to swing outward at the bottom. A similar unit, called the hopper type, is one in which the top of the sash swings inward. Figure 3-31 shows an awning type window with three (3) details and a typical combination of several awning windows in one unit. View A of figure 3-31 shows a cross section view of the head. View B is a cross section view of the horizontal mullion between the top and bottom sash. View C is a cross section view of the sill. The phantom lines in views A, B, and C represent the swing of the hopper type window.

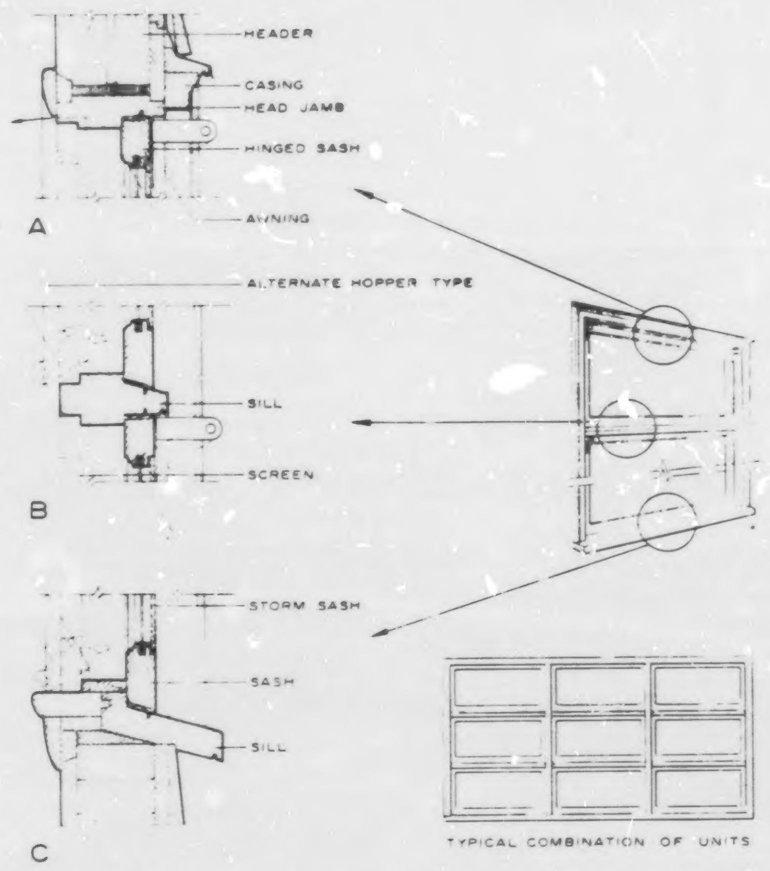

HEADER
CASING
HEAD JAMB
HINGED SASH
A
AWNING
ALTERNATE HOPPER TYPE
SILL
SCREEN
B
STORM SASH
SASH
SILL
C
TYPICAL COMBINATION OF UNITS

Fig 3-31. Awning window details.

Exterior door details. Most doors and their frames are preassembled at a factory and delivered to a construction site in the same manner as the windows which we discussed earlier. However, in military construction, the doors and their frames will usually be constructed on the job site. A door detail will be needed in order to accomplish this. Figure 3-32 shows a typical panel type exterior door and three door details. The head detail is shown in view A. View C shows the sill detail which is taken directly below the head detail at the bottom of the door. Views A and C are taken from the left side of the door looking toward the right side of the door. The jamb detail shown in view B is a plan view, looking down. Notice that all three views show a combination storm door used with the exterior door.

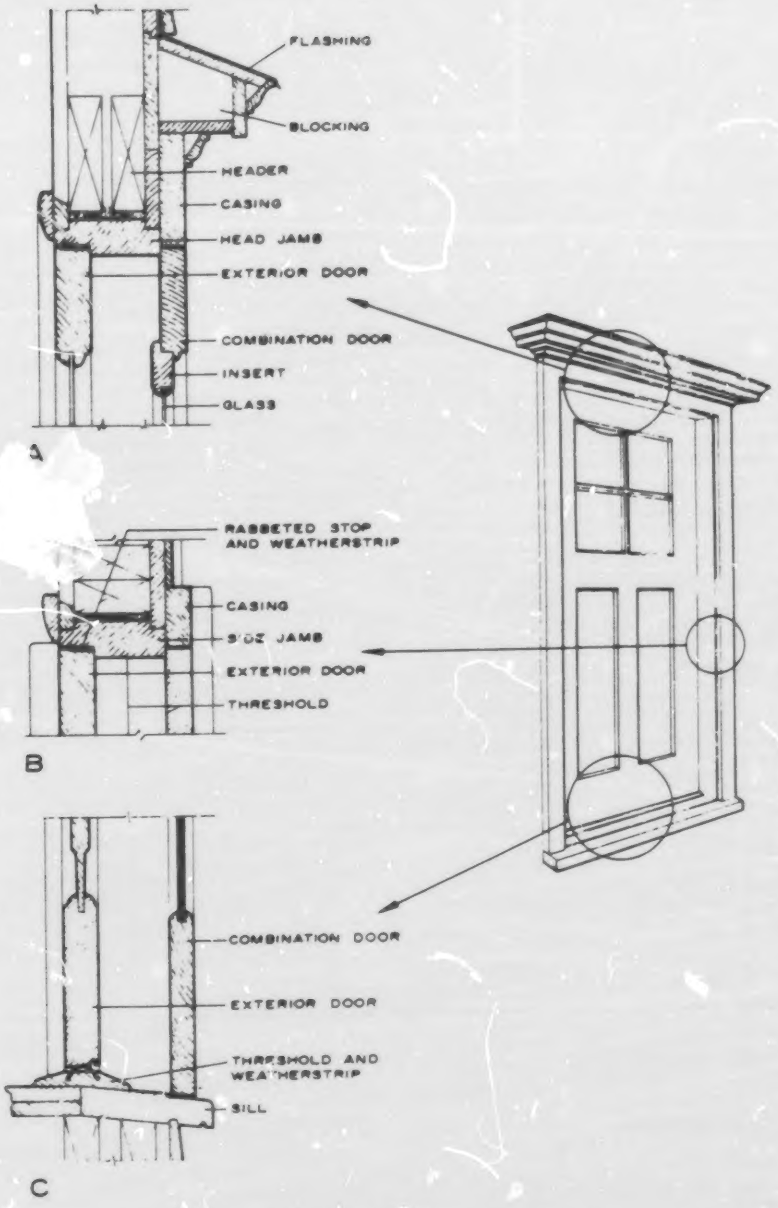
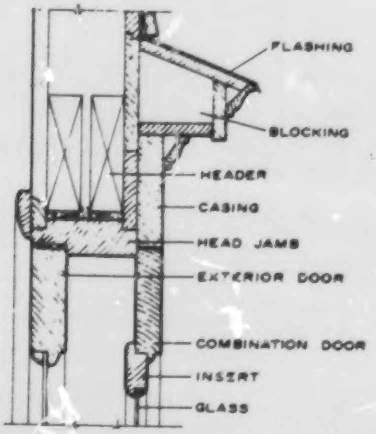

FLASHING
BLOCKING
HEADER
CASING
HEAD JAMB
EXTERIOR DOOR
COMBINATION DOOR
INSERT
GLASS
A
RABBETED STOP AND WEATHERSTRIP
CASING
SIDE JAMB
EXTERIOR DOOR
THRESHOLD
B
COMBINATION DOOR
EXTERIOR DOOR
THRESHOLD AND WEATHERSTRIP
SILL
C

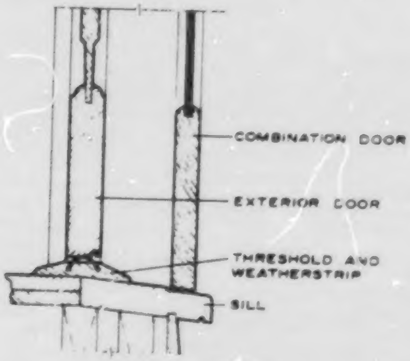
Fig 3-32. Typical exterior door details.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

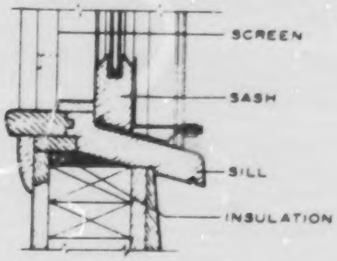
1. The illustration below is a head detail for a ________________________________.


FLASHING
BLOCKING
HEADER
CASING
HEAD JAMB
EXTERIOR DOOR
COMBINATION DOOR
INSERT
GLASS

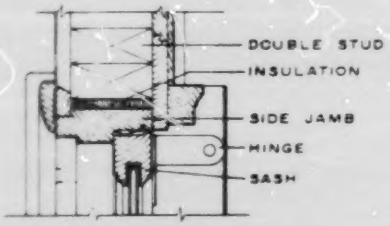
2. The door detail illustrated below is a detail drawing of the door________________


COMBINATION DOOR
EXTERIOR DOOR
THRESHOLD AND WEATHERSTRIP
SILL

3. The drawing illustrated below is a detail of a __________________________sill.


SCREEN
SASH
SILL
INSULATION

4. The illustration below is a detail of a window ______ ______________________________.



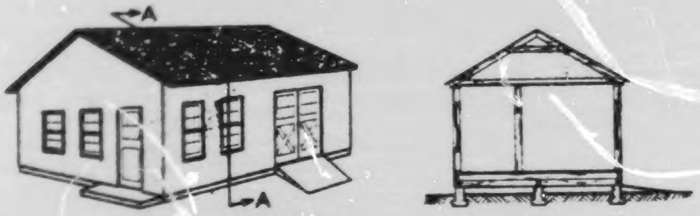
Work Unit 3-8. SECTION VIEWS

IDENTIFY A SECTION VIEW OF A FOUNDATION PLAN.

IDENTIFY, USING A WALL SECTION VIEW, ANY OF THE MATERIALS USED IN THE CONSTRUCTION OF THE BUILDING.

A section shows how a structure looks when cut vertically by a cutting plane. It is drawn to a scale showing details of a particular construction feature that cannot be given in the general drawing. The section provides information on height, materials, fastening, support systems, and concealed features. Section drawings are used to give a clear view of the interior or hidden features of the object which normally cannot be clearly observed in conventional outside views.

As mentioned in study unit 1, work unit 1-3, a section view is obtained by cutting away part of an object to show the shape and the construction at the cutting plane. The most common position of the cutting plane is through the longest dimension, or main longitudinal axis and parallel to the front view. The cutting plane will be identified by a double set of letters such as A-A, B-B, etc. The actual view of the section after it has been cut will also be identified by the same set of letters. Figure 3-33 shows a typical section view and how the cut was made through the building.



PERSPECTIVE VIEW

SECTION A-A

TYPICAL SMALL BUILDING SHOWING CUTTING PLANE A-A AND SECTION DEVELOPED FROM THE CUTTING PLANE

Fig 3-33. Development of a section view.

Section views of foundations. Foundations (both wall and column) will normally have section views included on a set of construction prints. Section views of the foundation will show the shape of the footing(s), materials used, size of materials used, and any unusual features about the foundation. Figure 3-34 shows a typical column foundation plan with the architect's note to see section view A-A and B-B on sheet 3 of the construction prints. This is the typical way an architect will let the builder know about a section view that will give the builder the needed information. Sections A-A and B-B are shown in figure 3-35.

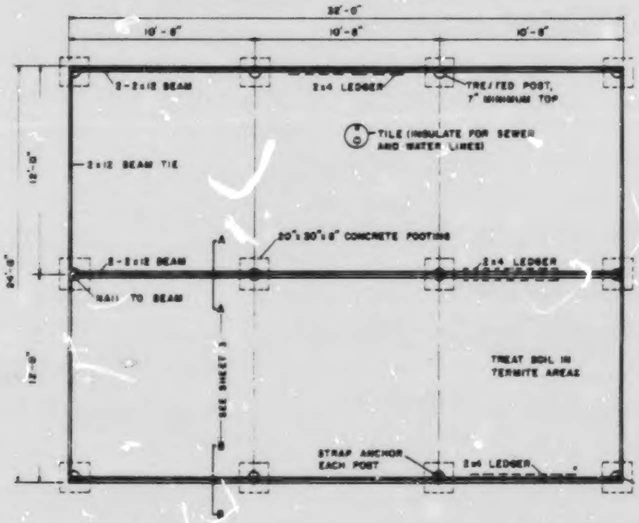

32'-0"
10'-8"
10'-8"
10'-8"
2-2x12 BEAM
2x4 LEDGER
TREATED POST, 7" MINIMUM TOP
TILE (INSULATE FOR SEWER AND WATER LINES)
2x12 BEAM TIE
12'-0"
24'-0"
12'-0"
20"x20"x8" CONCRETE FOOTING
2-2x12 BEAM
2x4 LEDGER
NAIL TO BEAM
A
A
SEE SHEET 3
TREAT SOIL IN TERMITE AREAS
STRAP ANCHOR EACH POST
2x4 LEDGER
B
B

Fig 3-34. Foundation indicating the section views that are available.

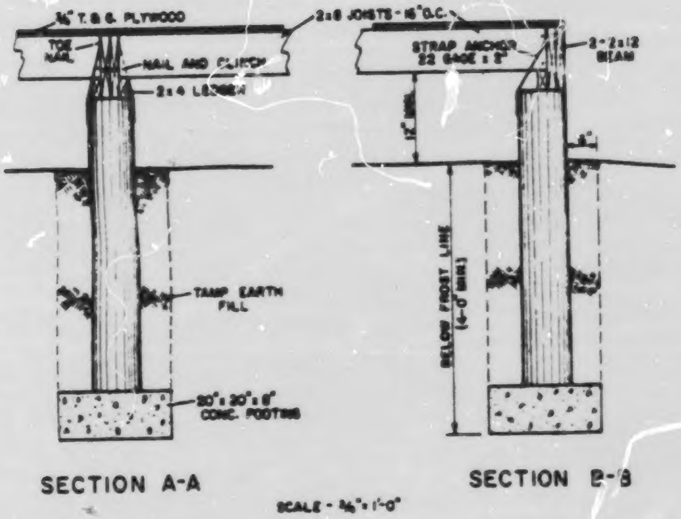

¾" T.& G. PLYWOOD
2x8 JOISTS - 16" O.C.
TOE NAIL
NAIL AND CLINCH
2x4 LEDGER
TAMP EARTH FILL
20"x20"x8" CONC. FOOTING
STRAP ANCHOR 22 GAGE x 2"
2-2x12 BEAM
12" MIN.
3"
BELOW FROST LINE (4'-0" MIN.)
SECTION A-A
SECTION B-B
SCALE - ¾" = 1'-0"

Fig 3-35. Section view of a column foundation.

Figure 3-36 shows a typical section view of a wall foundation. Note that the architect not only gives information about the materials used in the foundation, but also includes the materials used in the construction of the floor and wall.

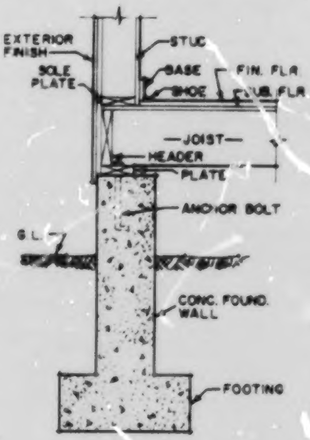


Fig 3-36. Typical section view of a wall foundation.

Wall section views. The wall section view is of primary importance to construction supervisors and to the craftsmen who do the actual building. The wall section shows the construction of the walls as well as the way in which structural members and other features are joined together. Since most wall sections extend vertically from the foundation to the roof, they will contain information not only about the wall, but also about the roof and foundation. Figure 3-37 shows a typical wall section view. Notice the large amount of structural information included on the section view illustrated. Information about exterior finish on both the wall and roof are shown (roof finish is 45# roll roofing over 1" x 8" sheathing). The wall will have 1/4" x 1/2" x 6" bevel siding for exterior finish and 1/2" gypsum for interior finish material.

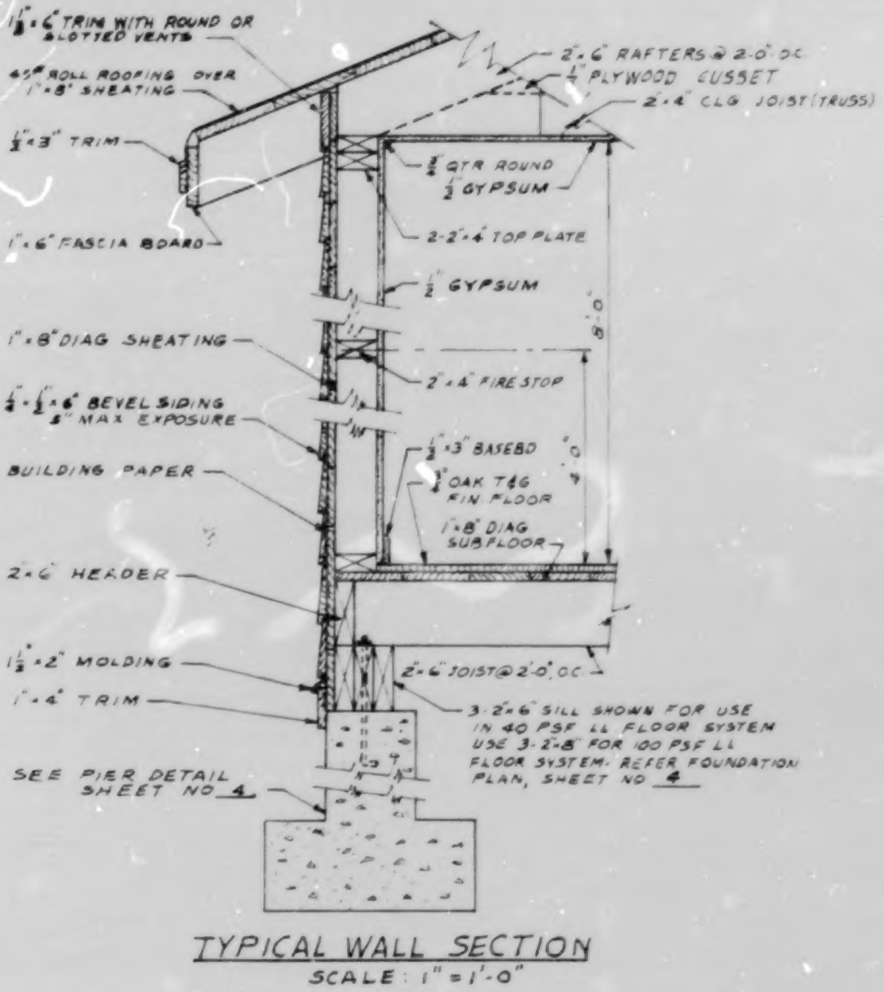
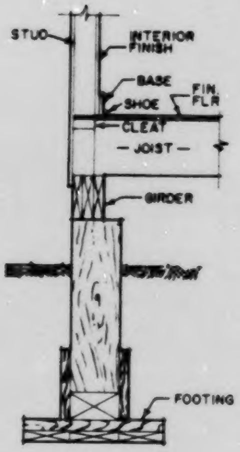

1 1/8" x 6" TRIM WITH ROUND OR SLOTTED VENTS
45# ROLL ROOFING OVER 1" x 8" SHEATING
1/2" x 3" TRIM
1" x 6" FASCIA BOARD
2" x 6" RAFTERS @ 2'-0" OC
1/4" PLYWOOD GUSSET
2" x 4" CLG JOIST (TRUSS)
3/4" QTR ROUND
1/2" GYPSUM
2-2" x 4" TOP PLATE
1/2" GYPSUM
8'-0"
1" x 8" DIAG SHEATING
2" x 4" FIRE STOP
1/4" - 1/2" x 6" BEVEL SIDING 5" MAX EXPOSURE
1/2" x 3" BASEBD
4'-0"
BUILDING PAPER
3/4" OAK T&G FIN FLOOR
1" x 8" DIAG SUBFLOOR
2 x 6" HEADER
1 1/2" x 2" MOLDING
2" x 6" JOIST @ 2'-0" OC
1" x 4" TRIM
3-2" x 6" SILL SHOWN FOR USE IN 40 PSF LL FLOOR SYSTEM USE 3-2" x 8" FOR 100 PSF LL FLOOR SYSTEM. REFER FOUNDATION PLAN, SHEET NO 4
SEE PIER DETAIL SHEET NO 4
TYPICAL WALL SECTION
SCALE: 1" = 1'-0"

Fig 3-37. Typical wall section view.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. What type of section view will give information about the size and shape of footings?

2. The illustration shown below is an example of a ________________ ______________ view.


STUD
INTERIOR FINISH
BASE
SHOE
FIN. FLR
CLEAT
— JOIST —
GIRDER
FOOTING

3. Foundation section views could show both column foundation or _________________ ______________________ views.

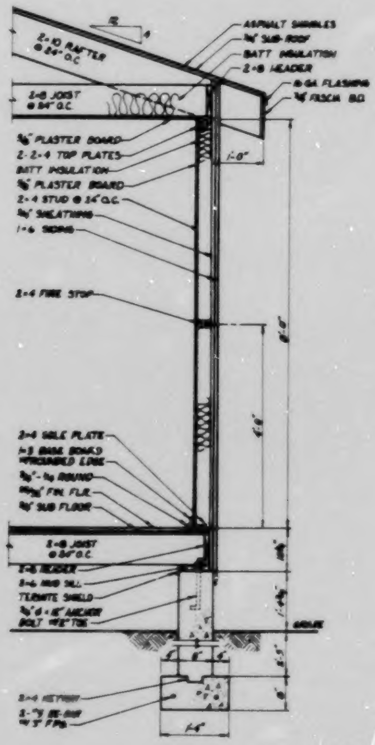
4. What type of section view will give information about the exterior finish?

____

5. What section view would give a builder information about the finish used on the roof?

____

Note: Questions 6 through 10 pertain to the illustration below.


12
4
2×10 RAFTER @ 24" O.C.
2×8 JOIST @ 24" O.C.
ASPHALT SHINGLES
3/4" SUB-ROOF
BATT INSULATION
2×8 HEADER
26 GA. FLASHING
3/4" FASCIA BD.
3/8" PLASTER BOARD
2-2×4 TOP PLATES
BATT INSULATION
3/8" PLASTER BOARD
2×4 STUD @ 24" O.C.
3/4" SHEATHING
1×6 SIDING
1'-0"
2×4 FIRE STOP
8'-0"
4'-0"
2×4 SOLE PLATE
1×3 BASE BOARD
3/4" FIN. FLR.
3/4" SUB FLOOR
2×8 JOIST @ 24" O.C.
2×8 HEADER
2×6 MUD SILL
TERMITE SHIELD
GRADE
2×4 KEYWAY
1'-4"

6. What type of material is used for the outside wall sheathing?

____

7. What size are the floor joists?

____

8. What type of material is used on the inside wall?

____

9. What size is the material used to finish the floor?

____

10. What type of shingles are to be used on the roof?

____

Section III. FRAMING PLAN

Framing plans show the size, number, and location of structural members which form the building frame work. Separate plans may be furnished for floors, walls, and roofs.

Work Unit 3-9. FLOOR FRAMING PLANS

IDENTIFY, FROM AN ILLUSTRATION, A FLOOR FRAMING PLAN.

Floor framing plan. Framing plans for floors are basically plan views of the girders and joists. The size and spacing of the joists, the size and number of girders, and the bridging are noted on the plan. A typical floor framing plan is shown in figure 3-38. By reading the floor framing plan, you learn that the girders will be made up of three 2 x 6's (or three 2 x 8's for 20-foot spans). The joists will be made up of 2 x 6's and are to be spaced at intervals of 3 feet (2" x 6" at 3'-0" O.C.) with bridging. The joist lengths are joined at the footings with 1 1/2 x 2-foot splices. Note that there are two types of footings indicated (type C and type D). Detailed views of footings, joists, girders, or foundations may be shown on the framing plan if the architect feels additional information is needed.

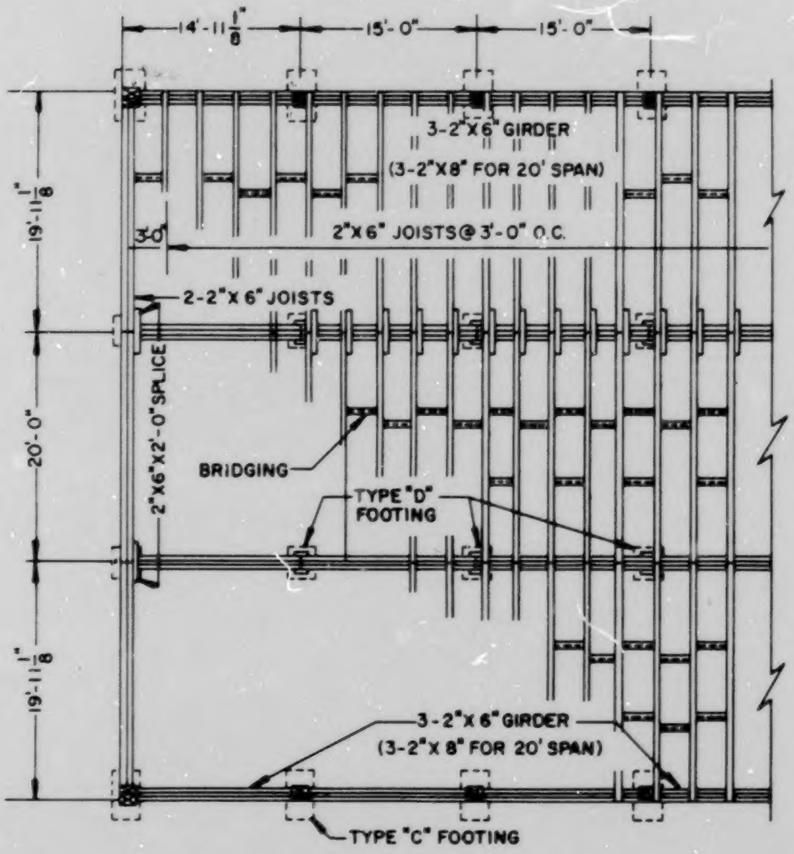
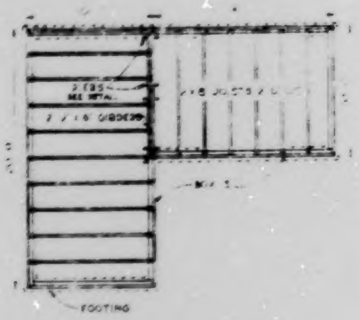

14'-11 1/8"
15'-0"
15'-0"
19'-11 1/8"
20'-0"
19'-11 1/8"
3-2"X6" GIRDER
(3-2"X8" FOR 20' SPAN)
3'-0"
2"X6" JOISTS@ 3'-0" O.C.
2-2"X6" JOISTS
2"X6"X2'-0" SPLICE
BRIDGING
TYPE "D" FOOTING
3-2"X6" GIRDER
(3-2"X8" FOR 20' SPAN)
TYPE "C" FOOTING

Fig 3-38. Floor framing plan.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. What plan would show the size and spacing of the joists, the size and number of the girders, and the type of bridging used?

2. The illustration below is an example of a ________________________ plan.



Work Unit 3-10. ROOF FRAMING PLAN

IDENTIFY, FROM AN ILLUSTRATION, A ROOF FRAMING PLAN.

Roof framing plan. Framing plans for roofs are very similar to floor framing plans and impart the same basic type of information. Normally shown is the size and spacing of rafters, ridgeboard, bearing walls, any roof openings, and other structural members in the roof as noted by the architect. Figure 3-39 shows a typical roof framing plan for a gable roof with a slope of 6 and 12 (6 inches of rise for every foot of run). After reading the plan, you can determine that the rafters will be 2 x 6's spaced 18 inches on center. A ridgeboard made up of 2" x 8" stock will be used in the roof. The framing plan also indicates an opening for a chimney. The rafters will extend 1 foot beyond the edge of the building.

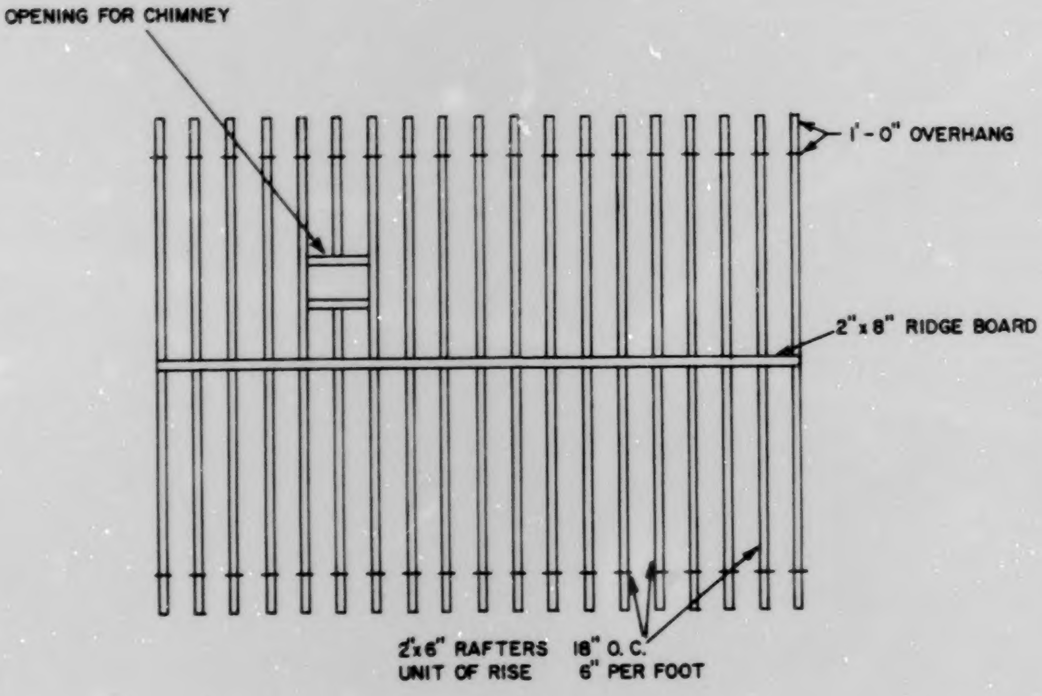

OPENING FOR CHIMNEY
1'-0" OVERHANG
2"x8" RIDGE BOARD
2"x6" RAFTERS
UNIT OF RISE
18" O.C.
6" PER FOOT

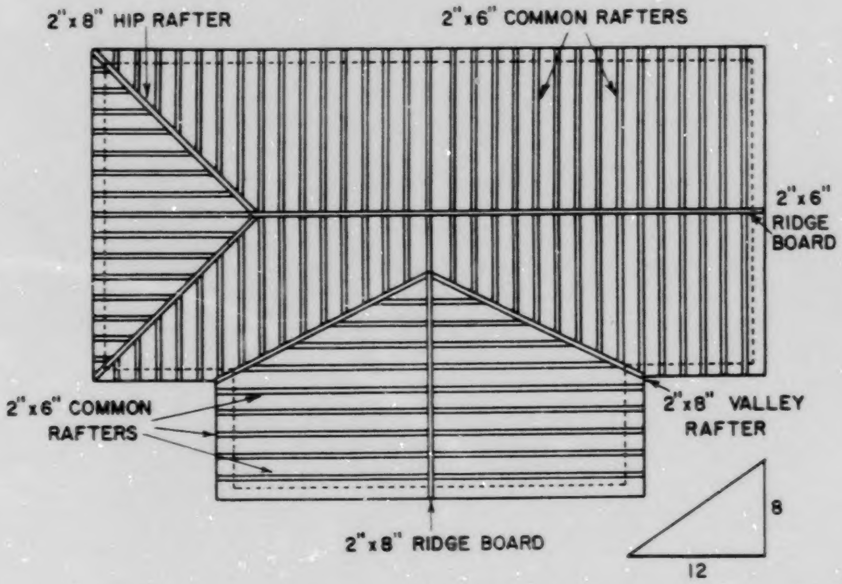
Fig 3-39. Roof framing plan.

EXERCISE: Answer the following questions and compare your answers with the answers in the back of the study unit.

1. What framing plan would show the size and spacing of the rafters?

   ____

2. The illustration below is an example of a __________________ __________________ plan.



Work Unit 3-11. WALL FRAMING PLAN

IDENTIFY, FROM AN ILLUSTRATION, A WALL FRAMING PLAN.

Wall framing plans (details). Wall framing plans (also called wall framing details) present information about the size and location of studs, diagonal bracing, cripples, trimmers, headers, fire blocks (girts), plates, and corner posts. The door and window framing can also be shown in a wall framing plan. Figure 3-40 shows both a typical wall framing plan and a detailed drawing that shows where wall framing members are located. Notice that the framing plan gives not only the size of the studs, but also gives the on-center spacing at 16". Wall framing plans can be as simple as the one illustrated in figure 3-40 or they may be very complicated. Their complexity will depend upon the amount of information that the architect is trying to include on the plan.

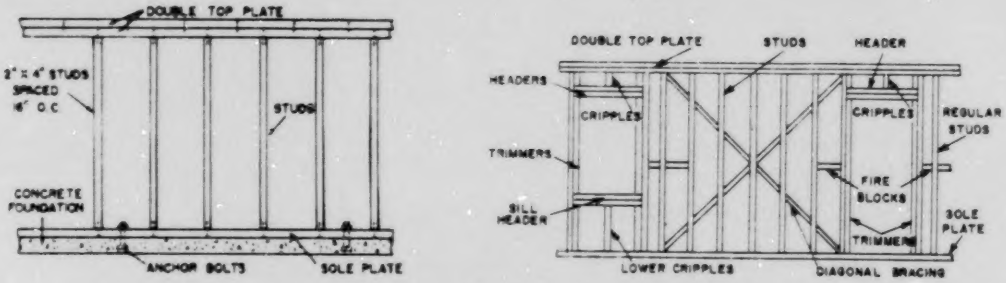
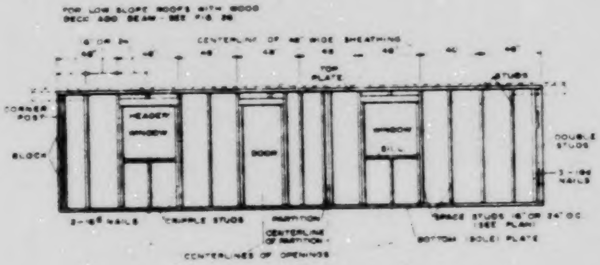

DOUBLE TOP PLATE
2" x 4" STUDS SPACED 16" O.C
STUDS
CONCRETE FOUNDATION
ANCHOR BOLTS
SOLE PLATE
DOUBLE TOP PLATE
STUDS
HEADER
HEADERS
CRIPPLES
CRIPPLES
REGULAR STUDS
TRIMMERS
FIRE BLOCKS
SILL HEADER
SOLE PLATE
TRIMMERS
LOWER CRIPPLES
DIAGONAL BRACING

Fig 3-40. Typical wall framing plan.

EXERCISE: Answer the following items about the illustration below. Compare your answers with the answers given at the end of the study unit.


CENTERLINE OF 48" WIDE SHEATHING
TOP PLATE
STUDS
CORNER POST
BLOCK
HEADER
WINDOW
DOOR
WINDOW
SILL
DOUBLE STUDS
3-16d NAILS
2-16d NAILS
CRIPPLE STUDS
PARTITION
CENTERLINE OF PARTITION
CENTERLINES OF OPENINGS
SPACE STUDS 16" OR 24" OC (SEE PLAN)
BOTTOM (SOLE) PLATE

1. The illustration is an example of a ____________________ framing plan.

2. What size nails are to be used to fasten the studs to the sole plate?

   ____

3. The stud spacing is to be either ______________________ or ________________ inches on center.

Section IV. TYPES OF FRAME CONSTRUCTION

There are four principal types of frame construction which are used today in the construction of light structures. They are platform (also called western), balloon, braced, and plank and beam. A brick veneer structure is also considered a frame structure because the internal or supporting structure is entirely of wood framing. Solid masonry construction such as brick or concrete block will not be discussed because of the limited use of masonry construction in the theater of operations. Braced frame, plank, and beam construction will not be discussed either. This section will concentrate on the platform and balloon framing methods which are the most widely used in the theater of operations.

Work Unit 3-12. PLATFORM FRAMING

IDENTIFY, FROM AN ILLUSTRATION, A PLATFORM FRAME DRAWING.

IDENTIFY, FROM AN ILLUSTRATION, ANY FOUR OF THE STRUCTURAL MEMBERS USED IN PLATFORM FRAMING.

Platform framing. The platform (also called western) frame is the most commonly used method in military construction. It is distinguished by the floor platforms independently framed as shown in figure 3-41, the second and third floors supported by studs one story in height. Framing of this type is fast, safe, and allows for extensive use of short materials.

Interior partitions and exterior walls are framed with material of the same length, thereby insuring proper balance in case of any shrinkage.

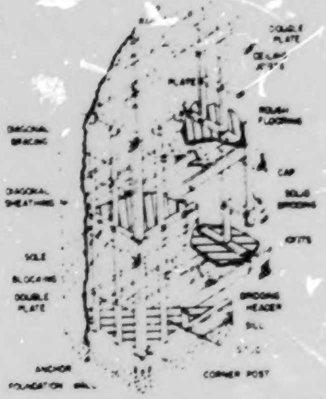

DOUBLE PLATE
CEILING JOISTS
PLATE
ROUGH FLOORING
DIAGONAL BRACING
CAP
DIAGONAL SHEATHING
SOLID BRIDGING
JOISTS
SOLE
BLOCKING
DOUBLE PLATE
BRIDGING
HEADER
SILL
STUD
ANCHOR
CORNER POST
FOUNDATION WALL

Fig 3-41. Platform (western) frame construction.

Because each floor is framed separately, the subfloor is laid "story by story" before the wall and partition studs are raised (fig 3-42). The studs are fastened to a sole plate that in turn is fastened through the subfloor to the floor joists. It is very difficult to install service pipe or wiring in these walls after they have been covered.

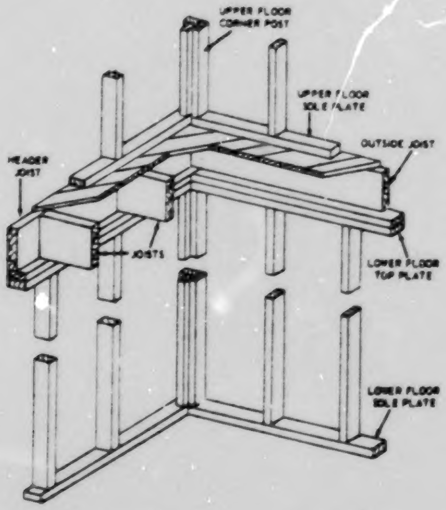

UPPER FLOOR CORNER POST
UPPER FLOOR SOLE PLATE
OUTSIDE JOIST
HEADER JOIST
JOISTS
LOWER FLOOR TOP PLATE
LOWER FLOOR SOLE PLATE

Fig 3-42. Method of framing upper-floor joists and studs in platform framing.

The platform frame is preferred for one-story structures since it permits both the bearing and nonbearing walls, which are supported by the joist, to settle uniformly.

Typical main components of the platform frame are the following:

(1) Wall studs. Studs are the closely spaced vertical members of partitions and outside walls. Their purpose is to support the weight of the upper floors and to provide a framework for exterior and interior finishes.

(2) Plates. A top plate is a horizontal member of a partition or frame wall. It serves as a cap for studs and support for the joists. The sole plate (bottom plate) serves as a rest for the studs.

(3) Bracing. Diagonal braces are permanent parts of a building which serve to stiffen the walls, keep the corners square and plumb, and prevent the frame from being distorted. The common types of bracing which you will use are let-in, set-in, and block bracing.

(4) Joists. Joists are laid edgewise to support the floor boards.

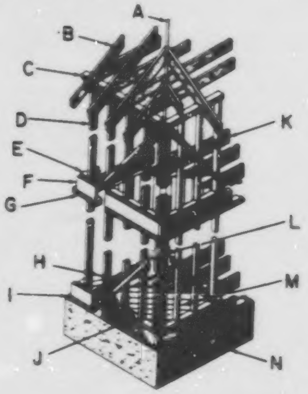
(5) Rafter. The ribs are run from hip, or ridge, to eaves in the roof.

(6) Sill. Sills are horizontal members that either rest upon or form the foundation of the house.

(7) Sheathing. Sheathing is generally applied diagonally to assist in strengthening the structure.

All of the aforementioned components are illustrated in figure 3-41.

EXERCISE: Answer the following questions about the illustration below. Compare your answers with the answers given at the end of the study unit.



1. The illustration shown is an example of ________________ framing.
2. In what location on the illustration would you find a stud?
3. In what location on the illustration would you find a joist?
4. At which location would you find a diagonal brace?
5. Which location indicates exterior wall sheathing?
6. Which location indicates the top plate?

Work Unit 3-13. BALLOON FRAMING

IDENTIFY, FROM AN ILLUSTRATION, A BALLOON FRAME DRAWING.

STATE THE MAJOR DIFFERENCE BETWEEN BALLOON FRAMING AND PLATFORM FRAMING.

Balloon framing. The major characteristic of the balloon frame shown in figure 3-43 is the use of studs extending from the sill (sole) plate to the rafters. Also, the joist ends are supported by ledge (or ribbon) boards and are nailed to the studs as shown in figure 3-44. The ribbon board is let into (seated in) the stud to form a rigid support for the joist. The balloon frame offers the advantages of speed and economy of construction as compared to the braced frame method. The continuous studs facilitate easy installation of service pipe, conduit, etc., without cutting through plates and weakening the structure. Corner braces for this frame are lighter than in the braced frame and are let into the outside edges of the studs.

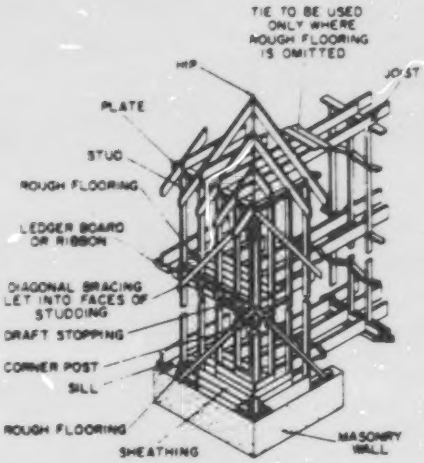

TIE TO BE USED ONLY WHERE ROUGH FLOORING IS OMITTED
HIP
JOIST
PLATE
STUD
ROUGH FLOORING
LEDGER BOARD OR RIBBON
DIAGONAL BRACING LET INTO FACES OF STUDDING
DRAFT STOPPING
CORNER POST
SILL
ROUGH FLOORING
SHEATHING
MASONRY WALL

Fig 3-43. Balloon frame construction.

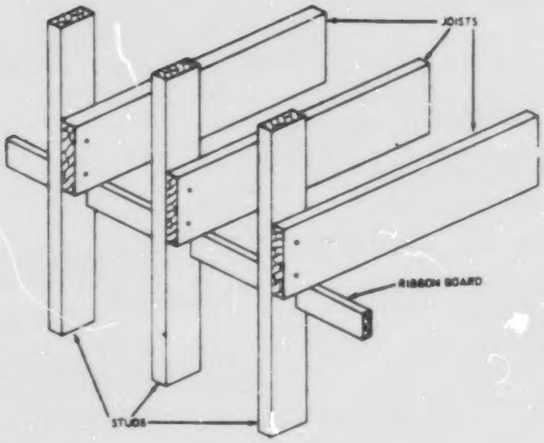
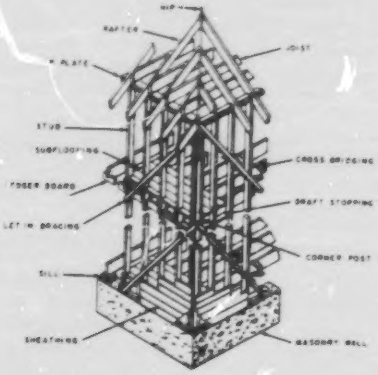

JOISTS
RIBBON BOARD
STUDS

Fig 3-44. Method of supporting upper floor joist ends in balloon framing.

EXERCISE: Answer the following questions and compare your answers with the answers given at the end of the study unit.

1. The illustration below is an example of ______________ frame construction.


HIP
RAFTER
JOIST
PLATE
STUD
SUBFLOORING
CROSS BRIDGING
LEDGER BOARD
DRAFT STOPPING
LET IN BRACING
CORNER POST
SILL
SHEATHING
MASONRY WALL

2. The major difference between platform and balloon frame construction is that in balloon framing the studs run from the ______________ plate to the ____________.

SUMMARY REVIEW

In the preceding work units, you have been introduced to the architect's scale and its uses. You are now able to determine dimensions from prints by using the architect's scale. You can locate and read various types of detail drawing and framing plans. You can also identify the two main types of frame construction used in the theater of operations as balloon and platform framing.

Answers to Study Unit #3 Exercises

Work Unit 3-1.

1. 1'-0" or 1 foot
2. graphic
3. 1/4" = 1'-0"

Work Unit 3-2.

1. 4"-7"
2. 4'-6"
3. 12'-11"
4. 12'-4"
5. 9'-9"

Work Unit 3-3.

1. 11'-6"
2. 21'-7 1/4"
3. 3'-8 3/4

Work Unit 3-4.

1. 1" = 1'-0"
2. 3/4" = 1'-0"

Work Unit 3-5.

1. shelf
2. stair (stairway)

Work Unit 3-6.

1. Cornice
2. stairs (stairway)

Work Unit 3-7.

1. door
2. sill
3. window
4. jamb

Work Unit 3-8.

1. Foundation
2. foundation section
3. wall foundation
4. wall section
5. Wall
6. 1" x 6" siding
7. 2" x 8"
8. 5/8" plaster board
9. 25/32
10. Asphalt

Work Unit 3-9.

1. Floor framing plan
2. Floor framing

Work Unit 3-10.

1. Roof framing plan
2. Roof framing

Work Unit 3-11.

1. wall
2. 16d
3. 16" or 24"

Work Unit 3-12.

1. platform
2. D
3. K
4. H
5. J
6. C

Work Unit 3-13.

1. Balloon
2. Sill (sole), rafter

STUDY UNIT 4

UTILITY, HEATING, AND AIR CONDITIONING

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL BE ABLE TO IDENTIFY UTILITY, HEATING, AND AIR CONDITIONING SYMBOLS AND ABBREVIATIONS. YOU WILL ALSO BE ABLE TO READ AND UNDERSTAND UTILITY, HEATING, AND AIR CONDITIONING PLANS.

The architect will make the original drawings of the job when construction projects are large. These drawings are known as working drawings; they are then printed and are known as working prints. At the same time, other sets of drawings are also prepared, each for the electrical work, for the plumbing, the heating and air conditioning and so on. However, for a small construction project, the architect will normally include the electrical plan, the plumbing plan, and the heating/air conditioning plan with the original set of drawings.

All builders and craftsmen should be able to read and understand the sections of the prints that pertain to their related fields. They should also have a general understanding of the information found on the other plans. Utility, heating, and air conditioning plans are used primarily by the craftsmen responsible for these functions, but they are important to the builder as well. Most utility, heating, and air conditioning installations require that openings be left in walls, floors, and roofs for the admission or installation of these features. The builder who is placing a concrete foundation wall must study the specialized utility/heating/air conditioning plans to determine the number, sizes, and locations of the openings he must leave for these operations.

Section I. ELECTRICAL PLANS

On military construction prints the electrical information normally is shown on the floor plans. Occasionally the electrical work is so complex that the information must be shown on a separate electrical plan. The electrical plan should show the locations of switches, light fixtures, receptacles, and in some cases electrical devices such as TV's, stoves, and dryers. An electrical wiring plan (diagram) showing all the wiring and cable runs may be included. Additional information will usually be shown in the specifications and schedules section of the construction prints.

This section will concentrate on the basic electrical plan and the symbols and abbreviations used on them.

Work Unit 4-1. ELECTRICAL SYMBOLS

IDENTIFY, FROM AN ILLUSTRATION, ANY THREE ELECTRICAL SYMBOLS.

Electrical symbols.

As mentioned in study unit 2, the architect uses symbols to furnish a lot of information in a very small space. Many of the electrical symbols will not have the same shape or features as those we talked about in study unit 2 on elevation drawings and floor plans. Many symbols are very similar in design and shape and the builder must use caution if there is any uncertainty about what the symbol represents. Normally the architect will show any unusual symbol in a legend on the electrical plan. Figure 4-1 shows some of the most commonly used electrical line symbols. Figure 4-2 shows some of the more commonly used switches, receptacle outlets, and lighting fixtures. Notice the similarity between a ceiling light fixture and a single receptacle outlet.

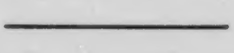
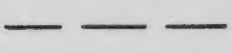
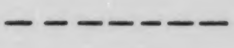
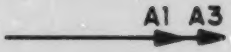
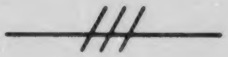
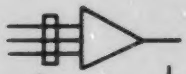
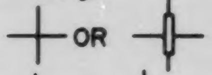
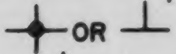
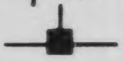
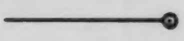
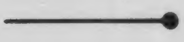
ITEM	SYMBOL
WIRING CONCEALED IN CEILING OR WALL	
WIRING CONCEALED IN FLOOR	
EXPOSED BRANCH CIRCUIT	
BRANCH CIRCUIT HOME RUN TO PANEL BOARD (NO. OF ARROWS EQUALS NO. OF CIRCUITS, DESIGNATION IDENTIFIES DESIGNATION AT PANEL)	
THREE OR MORE WIRES (NO. OF CROSS LINES EQUALS NO. OF CONDUCTORS TWO CONDUCTORS INDICATED IF NOT OTHERWISE NOTED)	
INCOMING SERVICE LINES	
CROSSED CONDUCTORS, NOT CONNECTED	
SPLICE OR SOLDERED CONNECTION	
CABLED CONNECTOR (SOLDERLESS)	
WIRE TURNED UP	
WIRE TURNED DOWN	

Fig 4-1. Line symbols for electrical wiring.

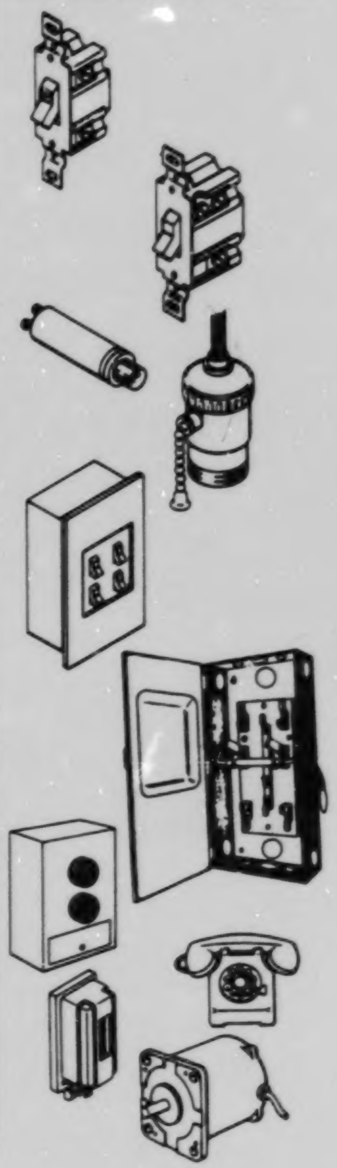
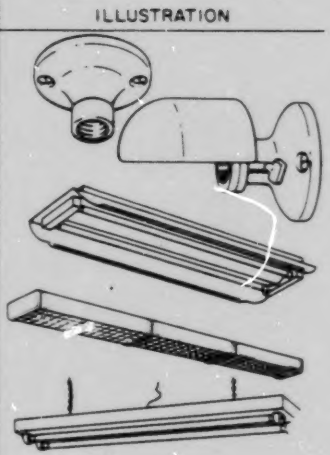
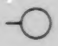
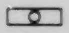
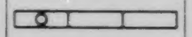
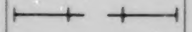
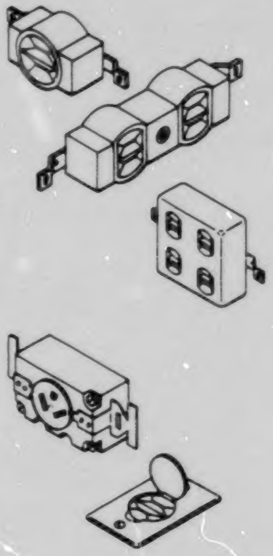
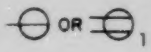
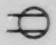
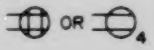
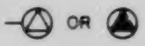
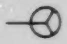
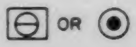
ITEM	SYMBOL	ILLUSTRATION
SWITCHES -		
SINGLE POLE SWITCH	S	
DOUBLE POLE SWITCH	S_2	
THREE WAY SWITCH	S_3	
SWITCH AND PILOT LAMP	S_p	
CEILING PULL SWITCH	Ⓢ	
PANEL BOARDS AND RELATED EQUIPMENT		
PANEL BOARD AND CABINET	▬	
SWITCHBOARD, CONTROL STATION OR SUBSTATION	▬	
SERVICE SWITCH OR CIRCUIT BREAKER	■ OR ■ OR ⊗	
EXTERNALLY OPERATED DISCONNECT SWITCH	▭	
MOTOR CONTROLLER	⊠ OR MC	
MISCELLANEOUS -		
TELEPHONE	▶	
THERMOSTAT	—Ⓣ	
MOTOR	Ⓜ	

Fig 4-2. Symbols for electrical fixtures and controls.

ITEM	SYMBOL	ILLUSTRATION
LIGHTING OUTLETS*-		
CEILING		
WALL		
FLUORESCENT FIXTURE		
CONTINUOUS ROW FLUORESCENT FIXTURE		
BARE LAMP FLUORESCENT STRIP		

*LETTERS ADDED TO SYMBOLS INDICATE SPECIAL TYPE OR USAGE

J- JUNCTION BOX R- RECESSED
L- LOW VOLTAGE X- EXIT LIGHT

ITEM	SYMBOL	ILLUSTRATION
RECEPTACLE OUTLETS**-		
SINGLE OUTLET		
DUPLEX OUTLET		
QUADRUPLEX OUTLET		
SPECIAL PURPOSE OUTLET		
20-AMP, 250-VOLT OUTLET		
SINGLE FLOOR OUTLET (BOX AROUND ANY OF ABOVE INDICATES FLOOR OUTLET OF SAME TYPE)		

**LETTER G NEXT TO SYMBOL INDICATES GROUNDING TYPE

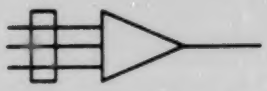
Fig 4-2. Symbols for electrical fixtures and controls--(continued).

EXERCISE: Answer the following questions and compare your responses with the answers listed at the end of the study unit.

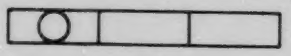
1. The symbol S_3 is the symbol for a(an)________________________________.
2. The symbol 0 is the symbol for a(an)________________________________.
3. The symbol —Ⓣ is the symbol for a(an)________________________________.

4. What is represented by the symbol illustrated below?

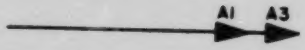
____



5. The illustration below is the symbol for______________________________

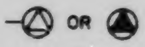


6. The illustration below is the symbol for______________________________



7. What is represented by the symbol illustrated below?

____



Work Unit 4-2. ELECTRICAL ABBREVIATIONS

MATCH, FROM A LIST, ANY THREE ELECTRICAL ABBREVIATIONS TO THEIR CORRECT TERMS.

Electrical plan abbreviations. Electrical plans can and do contain any amount of accepted abbreviations. The architect will use abbreviations when space is not available to letter the term in its entirety. Most architects will use an accepted form of abbreviation, but if there is any doubt, he will spell out the word completely. Many abbreviations can have more than one meaning. The abbreviation "F," for example, could represent "fan" or "furnace"; therefore, the builder must be very careful about his interpretation of an abbreviation. If there is any question about the meaning of an abbreviation, the builder should contact the architect or draftsman for the true meaning.

Table 4-1. Electrical plan abbreviations

TERM	ABBREVIATION
Access Panel	AP
Air Conditioning	AIR COND
Aluminum	AL
American Wire Gage	AWG
Ampere	A or AMP
Circuit	CIR
Circuit Breaker	CB
Clothes Dryer	CD
Conduit	C
Control Panel	CP
Copper	COP

Table 4-1. Electrical plan abbreviations--(continued)

TERM	ABBREVIATION
Cycle	CY
Diagram	DIAG
Direct Current	DC
Dishwasher	DW
Dryer	D
Electric Panel	EP
Fan	F
Fixture	F
Fluorescent	FLUOR
Furnace	F
Gage	GA
Garbage Disposal	GD
Grounded	G, GR, or GRD
Hertz	HZ
Horsepower	HP
Hotwater Heater	HWH
Junction Box	JB
Kilowatt	KW
Lamp	L
Line	L
Main Distribution Panel	MDP
Meter	M
Motor	M or MOT
National Electric Code	NEC
Negative	NEG
Neutral	N
Outlet	OUT
Panel	PNL
Phase	P
Pole	P
Positive	POS
Pull Chain	PC
Pull Switch	PS
Radiant Heater	RH
Radio	R
Range	R
Receptacle	R
Recessed	R
Refrigerator	REF
Relay	R
Service	SERV
Single Pole	1-P
Smoke Detector	SD
Specification	SPEC
Switch	S or SW
Switch Panel	SP
Telephone	TEL
Thermostat	T
Three Pole	3-P
Transformer	T
Two Pole	2-P
Underwriter's Laboratory	UL
Ungrounded	UNG
Utility Room	URM
Volt	V
Washing Machine	WM
Watt	W
Wire	W

EXERCISE: Column I below lists electrical plan abbreviations. Column II lists electrical plan terms. In the numbered blanks to the right of the abbreviation write the matching term for the abbreviation. Compare your responses with the answers listed at the end of the study unit.

Column 1 Abbreviations	Column 2 Terms
1. AP, ________________	Panel Switch
	Negative
2. CB, ________________	Outside
	Utility Room
3. DC, ________________	Citizen's Band
	Modulate
4. GR, ________________	1 - Per Unit
	Pull Switch
5. M, ________________	Single Pole
	Access Panel
6. NEG, ______________	Direct Current
	Circuit Breaker
7. OUT, ______________	Neutral
	Meter
8. PS, ________________	Grounded
	Dimmer Control
9. 1-P, ______________	Ampere
	Outlet
10. URM, ______________	Unground Lead
	Gage Regulator

Work Unit 4-3. READING ELECTRICAL PLANS

IDENTIFY, FROM AN ELECTRICAL PLAN, THE TOTAL CONNECTED LOAD ON ANY CIRCUIT.

IDENTIFY, FROM AN ELECTRICAL PLAN, THE CIRCUIT TO WHICH LIGHTING OUTLETS ARE CONNECTED.

Before a builder can read and understand the information found on an electrical print, he must have a basic knowledge of electrical terms, materials, and their application.

The electrical wiring system in a building is the installation which distributes electrical energy. It is frequently referred to as the "interior wiring system" to distinguish it from the "electrical distribution system" which includes outside power lines and equipment for multi-building installations.

The nomenclature of a building wiring system is divided into two principal parts according to function as follows:

Building Feeders and Subfeeders. A building feeder is a set of conductors which supply electricity to the building. A subfeeder is an extension of the feeder through a cutout, or switch, from one interior distribution center to another without branch circuits in between.

Branches or Branch Circuits. A branch circuit is a set of conductors, feeding through an automatic cutout, or fuse, and supplying one or more energy-consuming devices such as lights or motors.

A variety of materials and fittings are used in the installation of electrical wiring. Some common items you would use in theater of operations type construction are described in the following paragraphs.

Conductors. A conductor is any wire, bar, or ribbon, with or without insulation. It is usually made of copper because of the good electrical characteristics of that metal. The smallest size wire permitted for use in interior wiring systems is 14 AWG. The determination of the wire size to be used in circuits is dependent on the voltage drop coincident with each size. The size of the conductor used as a feeder to each circuit is also based on voltage drop. You should select the wire size so that the voltage drop from the branch circuit supply to the outlets will not be more than 3 percent. Table 4-2, which is based on an allowable 3 percent voltage drop, lists the wire sizes required for various distances between supply and load, at different load currents. Table 4-2 also lists the service-wire requirements and capacities. The minimum size for service-wire installation shall not be smaller than the size of the wire used for conductors of a branch circuit and in no case smaller than No. 12. Service-wires must not only meet the voltage-drop requirements but also be inherently strong enough to support their own weight, plus any additional loading caused by nature (ice, branches, and so on). Symbols are used on electrical plans to show the routing and interconnection of wiring. The symbols that you will most frequently encounter are shown in figure 4-1. Wiring may be divided into four classes according to the type of installation or the materials used.

a. Expedient wiring. There are many applications where electrical wiring installations are needed for temporary use. One example is a forward area installation. A complete installation including knobs, tubes, cleats, and damage protection would require too much time and would be impractical. Consequently, expedient wiring used for temporary buildings and forward areas does not require the mounting and protective devices used in permanent installations. Generally, the wires are attached to building members with nails, and pigtail sockets are used for outlets. Soldering is omitted and friction tape is used as a protective covering on the connections. Fixture drops, preferably pigtail sockets, are installed by tapping their leads to wires and then taping the taps. The sockets are supported by the tap wires.

b. Open wiring. Open wiring is the type of wiring most often used in theater of operation construction because of economy of materials and ease in making additions or alterations. Wiring is supported and separated on porcelain knobs, cleats and tubes or encased in a nonmetallic flexible casing called loom. Wiring exposed to possible mechanical damage is protected by running boards or railings. Taps or splices are supported.

Table 4-2. Minimum wire sizes

[illegible]															
			[illegible] (AWG)												
			[illegible]												
[illegible]	[illegible] (AWG)	[illegible] (AWG)	[illegible]	75	[illegible]	[illegible]	[illegible]	175	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	14	10	14	12	10	8	8	6	6	6	4	4	4		
20	14	10	12	10	8	8	6	6	6	4	4	2	2	2	2
25	12	8	10	8	8	6	6	4	4	4	2	2	2	1	1
30	12	8	10	8	8	6	4	4	4	2	2	1	1	0	0
35	12	6	8	6	6	4	4	4	2	2	1	1	0	0	2/0
40	10	6	8	6	6	4	4	2	2	2	1	0	0	2/0	2/0
45	10	6	8	6	4	4	2	2	2	1	0	0	2/0	2/0	3/0
50	10	6	8	6	4	4	2	2	2	1	0	2/0	2/0	3/0	3/0
55	8	4	6	4	4	2	2	2	1	0	2/0	2/0	3/0	3/0	4/0
60	8	4	6	4	4	2	2	1	1	0	2/0	3/0	3/0	4/0	4/0
65	8	4	6	4	4	2	2	1	0	2/0	2/0	3/0	4/0	4/0	
70	8	4	6	4	2	2	1	1	0	2/0	2/0	3/0	4/0	4/0	
75	6	4	6	4	2	2	1	0	0	2/0	3/0		4/0		
80	6	4	6	4	2	2	1	0	0	2/0	3/0	4/0	4/0		
85	6	4	4	4	2	1	1	0	2/0	3/0	3/0	4/0			
90	6	2	4	2	2	1	0	0	2/0	3/0	4/0	4/0			
95	6	2	4	2	2	1	0	2/0	2/0	3/0	4/0				
100	4	2	4	2	2	1	0	2/0	2/0	3/0	4/0				

[illegible]															
			[illegible]												
[illegible]	[illegible] (AWG)	[illegible] (AWG)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	14	12	14	12	10	8	8	8	6	6	6	4	4	4	2
20	14	10	12	10	8	8	6	6	6	4	4	4	2	2	2
25	12	8	10	8	8	6	6	6	4	4	2	2	2	2	1
30	12	8	10	8	6	6	6	4	4	2	2	2	1	1	0
35	12	6	10	8	6	6	4	4	4	2	2	1	1	0	0
40	10	6	8	6	6	4	4	4	2	1	1	1	0	0	2/0
45	10	6	8	6	4	4	4	2	2	2	1	0	0	2/0	2/0
50	10	6	8	6	4	4	2	2	2	1	0	0	2/0	2/0	3/0
55	8	6	8	6	4	4	2	2	2	1	0	2/0	2/0	3/0	3/0
60	8	6	6	6	4	2	2	2	1	0	0	2/0	3/0	3/0	4/0
65	8	4	4	4	4	2	2	2	1	0	2/0	2/0	3/0	3/0	4/0
70	8	4	6	4	4	2	2	1	1	0	2/0	3/0	3/0	4/0	4/0
75	6	4	6	4	2	2	2	1	0	2/0	2/0	3/0	4/0	4/0	
80	6	4	6	4	2	2	1	1	0	2/0	3/0	3/0	4/0	4/0	
85	6	4	6	4	2	2	1	0	0	2/0	3/0	4/0	4/0		
90	6	4	6	4	2	2	1	0	0	2/0	3/0	4/0	4/0		
95	6	4	6	4	2	1	1	0	2/0	3/0	3/0	4/0			
100	4	2	4	2	2	1	0	0	2/0	3/0	4/0	4/0			
125	4	2	4	2	1	0	2/0	2/0	3/0	4/0					
150	2	2	2	2	0	2/0	2/0	3/0	4/0						
175	2	1	2	1	0	2/0	3/0	4/0	4/0						
200	1	0	1	0	2/0	3/0	4/0	4/0							
225	0	0	0	0	2/0	3/0	4/0								
250	2/0	2/0	2/0	2/0	3/0	4/0									
275	3/0	3/0	3/0	3/0	3/0	4/0									
300	3/0	3/0	3/0	3/0	4/0										
325	4/0	4/0	4/0	4/0											

c. Armored cable wiring. Armored cable, commonly called BX, provides mechanical damage protection without additional protective provisions. All connections and splices are made within boxes, usually with wire nuts. Cables are run through holes in building members or supported by staples or straps. Nonmetallic sheathed cable is sometimes used for interior wiring also. Connections and supports are similar to the ones in armored cable wiring.

d. Conduit wiring. Rigid or thin-wall conduit wiring provides the highest quality and most expensive installation. Rigid or thin-wall pipe is used to support and protect the conductors. Splices and taps are made at junction boxes or outlet boxes. Very little additional support or mechanical damage protection is required beyond that provided by the conduit.

Fixtures. The various switches and outlets, such as lighting fixtures and receptacles, are shown by symbols on interior wiring plans. The most frequently encountered symbols are shown in figure 4-2.

Fuse Boxes and Circuit Breakers. Each branch circuit is connected to some protective device, usually at the point where electrical service enters the building. Sub-feeders and additional protective devices may be used for devices such as motors.

a. Fuses. The device that automatically opens a circuit when the current rises beyond the safety limit is technically called a cutout, but more commonly it is called a fuse. All circuits and electrical apparatus must be protected from short circuits or dangerous overcurrent conditions by using correctly rated fuses. The cartridge type fuse is used for current rating above 30 amperes in interior wiring systems. The plug or screw type fuse is satisfactory for incandescent lighting or heating appliance circuits. Time-lag fuses should be used on branch circuits, wherever motors are connected, instead of the standard plug or cartridge type fuse. These fuses have self-compensating elements which maintain and hold the circuit in line during a momentary heavy ampere drain, yet cut out the circuit under short--circuit conditions. As you know, the heavy ampere demand normally occurs in motor circuits when the motor is started.

b. Fuse Boxes. As a general rule the fusing of circuits is concentrated at centrally located fuse or distribution panels. These panels are normally located at the service-entrance switch in small buildings or installed in several power centers in large buildings. The number of service centers or fuse boxes in the latter case would be determined by the connected power load.

c. Circuit breakers. A circuit breaker is a protective switching device designed to open a current-carrying circuit under overload, high or low voltage, or short-circuit conditions, and it is sometimes substituted for the entrance switch in small building electrical installations. No fuses are used in the circuit breaker. The breaker is generally operated automatically, although manual operation is also provided. As a rule, no detailed wiring diagram for a circuit breaker is shown on construction prints since such diagrams are to be found on the inside of the circuit breaker box cover.

Reading electrical plans. Electrical plans show what items are to be installed, their approximate location, and the circuits to which they are to be connected. A typical electrical plan for a post exchange is shown in figure 4-3. The plan shows that the incoming service consists of three No. 8 wires and that two circuit-breaker panels are to be installed. Starting at the upper left, the plan shows that nine ceiling lighting outlets and two duplex wall outlets are to be installed in the bulk storage area. The arrow designated "B2" indicates that these outlets are to be connected to circuit 2 of circuit-breaker panel B. Note that three wires are indicated from this point to the double home-run arrows designated "B1, B2". These are the hot wire from the bulk storage area to circuit 2 of panel B, the hot wire from the administration area to circuit 1 of panel B, and a common neutral. From the double arrowhead, these wires are run to the circuit breaker panel without additional connections. This run is shown at the left side of figure 4-4, which is typical of the ceiling wiring diagram provided, for open wiring of medium or extreme complexity. Note that the entire installation is not shown in figure 4-4. The diagram shows the splices, support and insulator arrangements used. Note that this is a physical drawing rather than a symbolic one, so each line represents a single wire rather than a pair of conductors as in the plan. A note calls out a circuit breaker installation detail at the point where the wires are down to the circuit-breaker panel, and the arrowheads on the leader from the note show the direction from which the circuit breaker installation detail is drawn. The circuit breaker panel installation detail (fig 4-5) shows the installation arrangement for the circuit breakers, including grounding, splices, and connections to the incoming service. Note that the circuit breaker panels are placed 5 feet 6 inches from the floor line. You can also see that a 3/4-inch pipe driven 8 feet into the ground is used for grounding the No. 8 ground wire.

In some installations alternate outlets are connected to different circuits so that half the lighting may be turned on at one time, and only part of the service will be out if a circuit breaker is tripped. For these purposes, the circuit identification (A1, B1, etc.) is noted alongside each fixture in the plans.

Usually, wiring plans are not provided for the fixtures. If the connections are not obvious, diagrams are normally supplied with the device. A three-way switch circuit, which enables the control of a single outlet from two locations, is shown in figure 4-6. On an electrical plan you will find the three-way switch is indicated by the symbol S3.

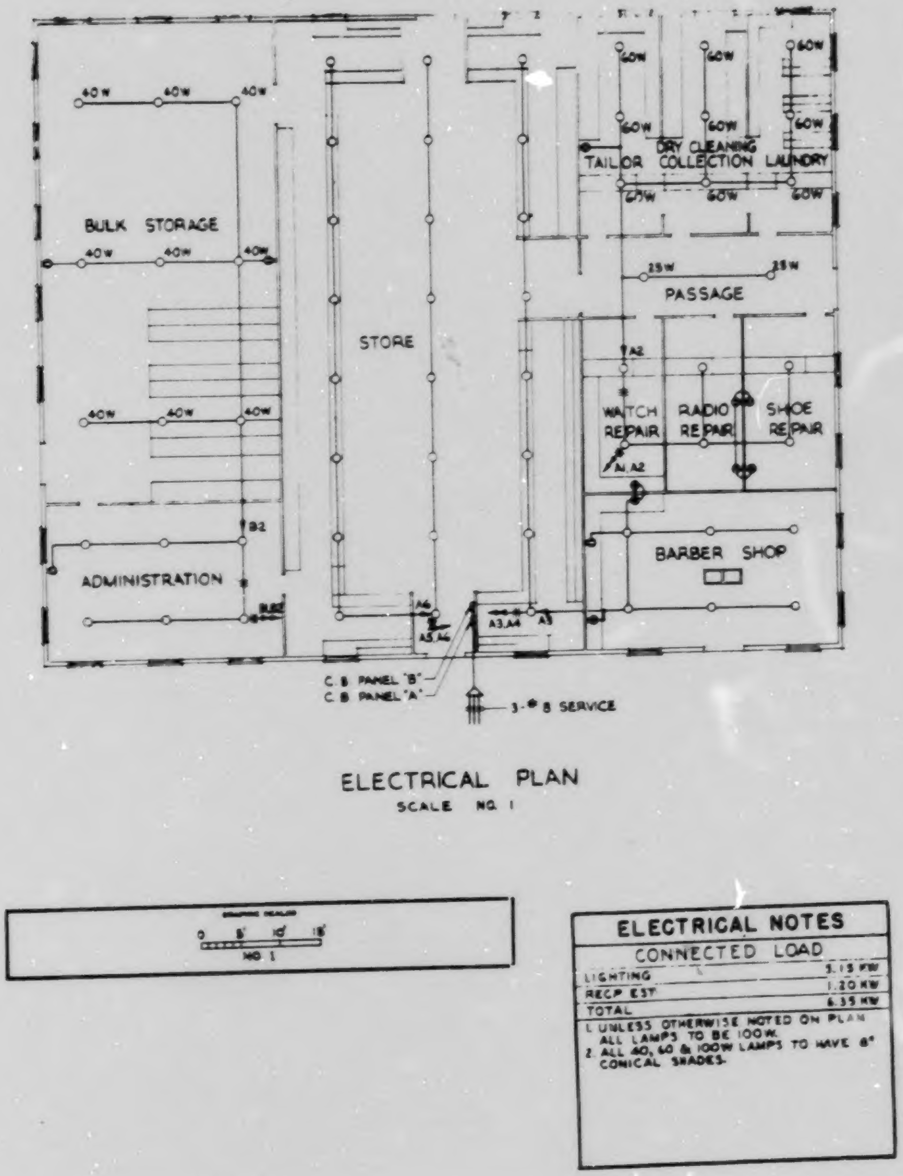

BULK STORAGE
40W
60W
25W
STORE
TAILOR
DRY CLEANING COLLECTION
LAUNDRY
PASSAGE
WATCH REPAIR
RADIO REPAIR
SHOE REPAIR
BARBER SHOP
ADMINISTRATION
A2
A1, A2
B2
A6
A5, A6
A3, A4
A3
C.B. PANEL "B"
C.B. PANEL "A"
3-Φ B SERVICE
ELECTRICAL PLAN
SCALE NO. 1
0 5' 10' 15'
NO 1
ELECTRICAL NOTES
CONNECTED LOAD
LIGHTING 5.15 KW
RECP EST 1.20 KW
TOTAL 6.35 KW
1. UNLESS OTHERWISE NOTED ON PLAN ALL LAMPS TO BE 100W.
2. ALL 40, 60 & 100W LAMPS TO HAVE 8" CONICAL SHADES.

Fig 4-3. Typical electrical plan.

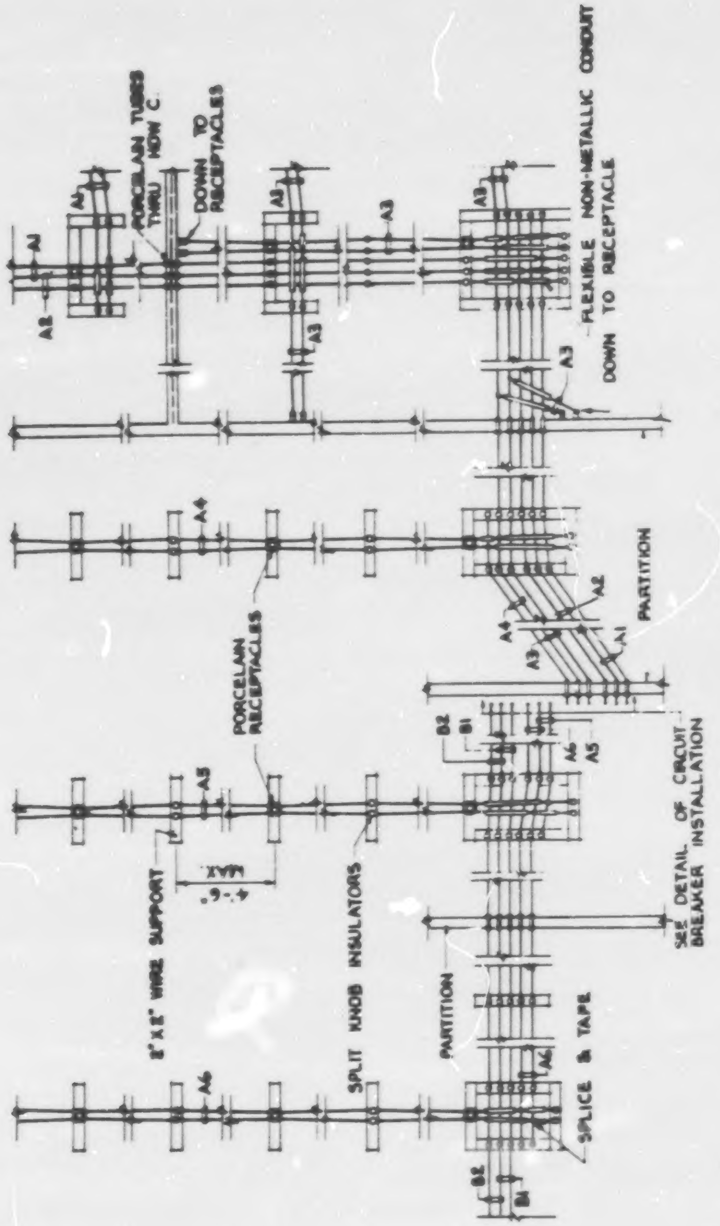

A2
A1
PORCELAIN TUBES THRU HOW C
DOWN TO RECEPTACLES
A3
A3
A3
A3
FLEXIBLE NON-METALLIC CONDUIT DOWN TO RECEPTACLE
A3
A4
PORCELAIN RECEPTACLES
PARTITION
A2
A1
A3
A4
B2
B1
A6
A5
SEE DETAIL OF CIRCUIT BREAKER INSTALLATION
A5
2"x2" WIRE SUPPORT
4'-6" MAX.
SPLIT KNOB INSULATORS
PARTITION
A6
SPLICE & TAPE
A6
B2
B1

Fig 4-4. Typical ceiling wiring diagram.

The total load on any one circuit can be determined by adding the total requirements for each lighting outlet on any circuit. Each outlet requirement will either be noted at its location or in the electrical notes included with the plan. Figure 4-3 shows the outlets for circuit B2 and their watt requirements at 40 watts each. There are nine outlets on the circuit at 40 watts each; therefore, there is a total requirement or load of 360 watts for circuit B2. A kilowatt contains 1,000 watts.

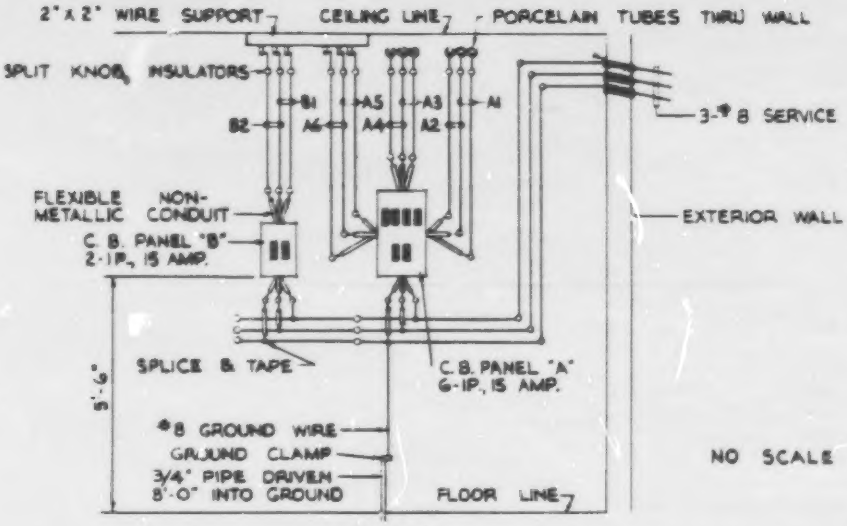

2" x 2" WIRE SUPPORT
CEILING LINE
PORCELAIN TUBES THRU WALL
SPLIT KNOB INSULATORS
B1
A5
A3
A1
B2
A6
A4
A2
3-#8 SERVICE
FLEXIBLE NON-METALLIC CONDUIT
C. B. PANEL "B" 2-1P., 15 AMP.
EXTERIOR WALL
SPLICE & TAPE
C.B. PANEL "A" 6-1P., 15 AMP.
5'-6"
#8 GROUND WIRE
GROUND CLAMP
3/4" PIPE DRIVEN 8'-0" INTO GROUND
FLOOR LINE
NO SCALE

Fig 4-5. Typical circuit breaker panel installation detail.

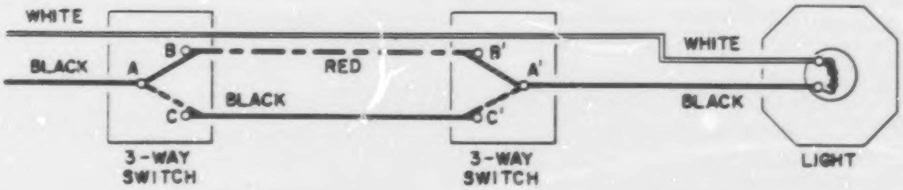

WHITE
BLACK
A
B
C
RED
BLACK
B'
A'
C'
WHITE
BLACK
3-WAY SWITCH
3-WAY SWITCH
LIGHT

Fig 4-6. Wiring diagram for a three-way switch.

EXERCISE: Refer to figure 4-3 to answer the following questions. Compare your responses with the answers listed at the end of this study unit.

1. The lighting outlets in the radio repair area are connected to which circuit?

2. The center row of lighting outlets in the store area is connected to which circuit?

3. The right-hand row of lighting outlets in the store area is connected to which circuit?

4. What is the total connected load on circuit A6?

5. What is the total connected load on circuit A2?

____

6. What is the total connected load on circuit B1?

____

7. Circuit A5 shares a common neutral wire with which other circuit?

____

Section II. PLUMBING PLANS

All piping, apparatus, and fixtures for water distribution and waste disposal within a building are classified as plumbing. Piping for heating systems is called steam fitting and is covered in section III of this study unit. This section will primarily discuss the plumbing within a building and not how water/waste is distributed within the main water/sewage systems.

Work Unit 4-4. PLUMBING SYMBOLS

IDENTIFY, FROM AN ILLUSTRATION, ANY THREE PLUMBING SYMBOLS.

Plumbing symbols. As a rule, plumbing plans show the location of fixtures and fittings to be installed and the size and routing of piping. Details are left to the plumber who is responsible for installing a properly connected system in accordance with good plumbing and construction practices. Plumbing plans consist generally of four types of symbols:

a. Line symbols for piping

b. Pipe-fitting symbols for pipe unions, couplings, and connections

c. Valve symbols to indicate the required control points in the system

d. Symbols indicating the various plumbing fixtures required by the plan

Before trying to read a plumbing plan, the builder should familarize himself with the symbols and explanation of these symbols given in this work unit.

Piping symbols. The type and location of piping will be indicated on the plans by a solid or dash-line. Figure 4-7 shows the standard symbols used on piping diagrams. The size of the required piping will be noted alongside each leg on the plan. An example of sizing can be seen on figure 4-8. Piping up to 12 inches in diameter is referred to by its nominal size, which is approximately equal to the inside diameter. The exact inside diameter will depend on the grade of pipe; heavy grades of piping have smaller inside diameters because of their greater wall thickness. Piping over 12 inches in diameter is classified and referred to by its actual outside diameter.

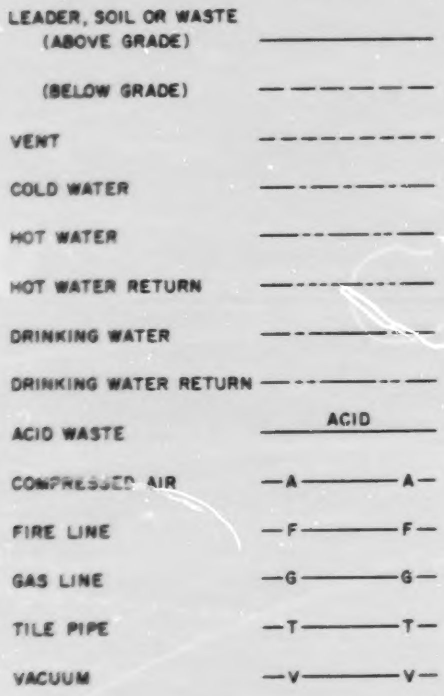

LEADER, SOIL OR WASTE (ABOVE GRADE)
(BELOW GRADE)
VENT
COLD WATER
HOT WATER
HOT WATER RETURN
DRINKING WATER
DRINKING WATER RETURN
ACID WASTE
ACID
COMPRESSED AIR
A A
FIRE LINE
F F
GAS LINE
G G
TILE PIPE
T T
VACUUM
V V

Fig 4-7. Line symbols for piping.

Fittings. Figure 4-8 illustrates the symbols used for the most frequently encountered pipe fittings. A more complete list is contained in appendix B. Note that the basic line symbol for a section of pipe shown at the top of figure 4-8 will actually be combined with the line symbology shown in figure 4-7. In this way, you are able to determine not only the size of pipe and method of branching and coupling but also the use to which the pipe will be put. This is important, in that the type of material from which the pipe is made determines how the pipe should be used. This subject will be discussed in detail in later paragraphs.

Valves. Figure 4-9 illustrates the symbols used for the most frequently encountered valves. A more complete list is contained in appendix B. Material and sizes for valves are normally not noted on drawings but must be assumed from the size and material of the connected pipe. However, when specified on a bill of materials or plumbing takeoff, valves are called out by size, type, material, and working pressure. For example: 2-inch check valve, brass, 175 pounds working pressure.

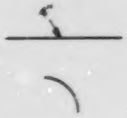
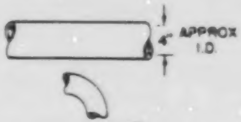
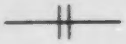
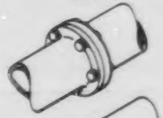
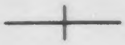
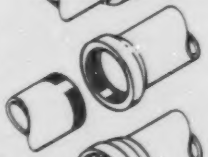
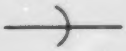
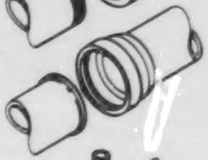
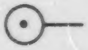
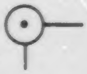
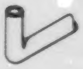
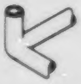
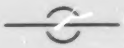
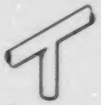
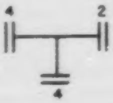
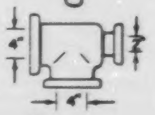
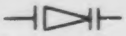
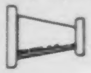
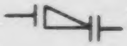
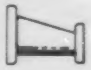
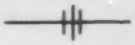
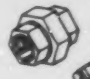
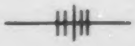
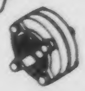
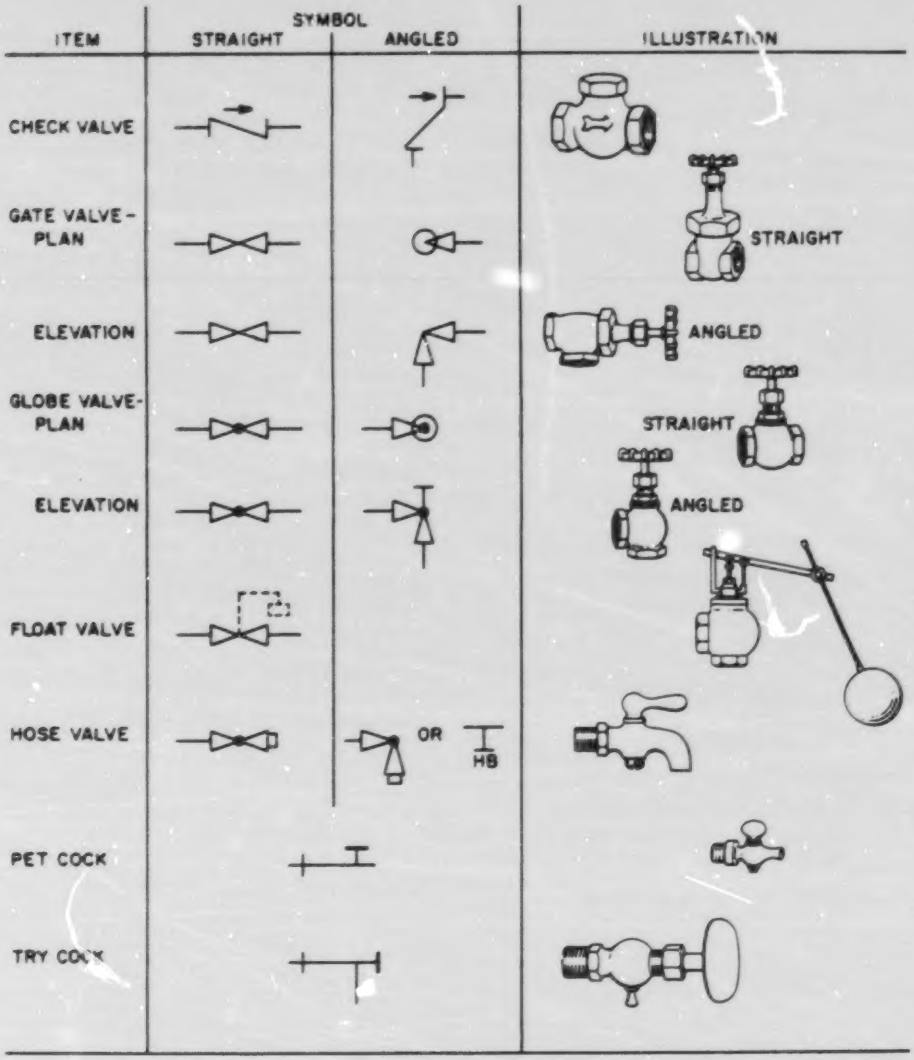
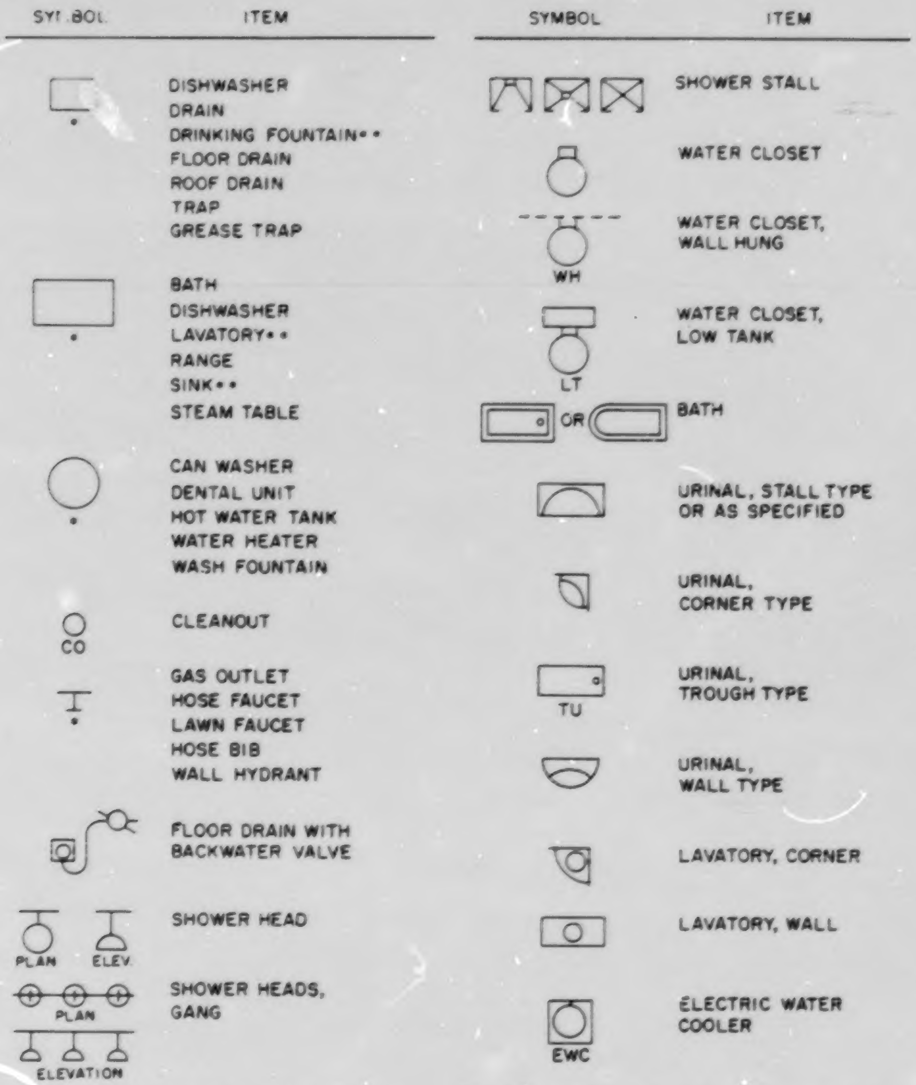
ITEM	SYMBOL	SAMPLE APPLICATION (S)	ILLUSTRATION
PIPE	SINGLE LINE IN SHAPE OF PIPE—USUALLY WITH NOMINAL SIZE NOTED		
JOINT—			
FLANGED	DOUBLE LINE		
SCREWED	SINGLE LINE		
BELL AND SPIGOT	CURVED LINE		
OUTLET TURNED UP	CIRCLE AND DOT	 	 
OUTLET TURNED DOWN	SEMICIRCLE		
REDUCING OR ENLARGING FITTING	NOMINAL SIZE NOTED AT JOINT		
REDUCER			
CONCENTRIC	TRIANGLE		
ECCENTRIC	TRIANGLE		
UNION			
SCREWED	LINE		
FLANGED	LINE		

Fig 4-8. Pipe fitting symbols.


ITEM
SYMBOL
STRAIGHT
ANGLED
ILLUSTRATION
CHECK VALVE
GATE VALVE-PLAN
STRAIGHT
ELEVATION
ANGLED
GLOBE VALVE-PLAN
STRAIGHT
ELEVATION
ANGLED
FLOAT VALVE
HOSE VALVE
OR
HB
PET COCK
TRY COCK

NOTE: SYMBOLS ARE SHOWN FOR SCREWED FITTINGS - SYMBOLS FOR JOINTS (FIG. 11-2) ARE ADDED FOR OTHER TYPES

Fig 4-9. Plumbing symbols for valves.


SYMBOL
ITEM
DISHWASHER
DRAIN
DRINKING FOUNTAIN**
FLOOR DRAIN
ROOF DRAIN
TRAP
GREASE TRAP
BATH
DISHWASHER
LAVATORY**
RANGE
SINK**
STEAM TABLE
CAN WASHER
DENTAL UNIT
HOT WATER TANK
WATER HEATER
WASH FOUNTAIN
CO
CLEANOUT
GAS OUTLET
HOSE FAUCET
LAWN FAUCET
HOSE BIB
WALL HYDRANT
FLOOR DRAIN WITH BACKWATER VALVE
PLAN
ELEV.
SHOWER HEAD
PLAN
ELEVATION
SHOWER HEADS, GANG
SYMBOL
ITEM
SHOWER STALL
WATER CLOSET
WH
WATER CLOSET, WALL HUNG
LT
WATER CLOSET, LOW TANK
OR
BATH
URINAL, STALL TYPE OR AS SPECIFIED
URINAL, CORNER TYPE
TU
URINAL, TROUGH TYPE
URINAL, WALL TYPE
LAVATORY, CORNER
LAVATORY, WALL
EWC
ELECTRIC WATER COOLER

*STANDARD ABBREVIATION INCLUDED WITH SYMBOL

**TYPE SHOULD BE GIVEN IN SPECIFICATION OR NOTE WHEN THIS SYMBOL IS USED

Fig 4-10. Symbols for plumbing fixtures.

Fixtures. General appurtenances such as drains and sumps and fixtures such as sinks, water closets, and shower stalls are indicated on the plans by pictorial or block symbols. The symbols for those most frequently encountered are illustrated in figure 4-10. The extent to which the symbols are used depends on the nature of the drawing. In many cases, the fixtures will be specified on a bill of materials or other schedules keyed to the plumbing plan. When the fixtures are described on the schedule, the draftsman will often use symbols which closely approximate the shape of the actual fixtures rather than the standard block or circle and the standard abbreviation.

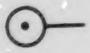
EXERCISE: Answer the following questions and compare your responses with the answers listed at the end of this study unit.

1. The line symbol ________________ is the symbol for a(an)____________________.

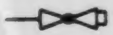
2. The line symbol _______G_________G_________ is the symbol for a(an)___________.

3. What is represented by the symbol illustrated below?

____

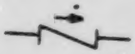


4. The illustration below is the symbol for a(an)______________________________.

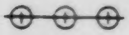


5. What is represented by the symbol illustrated below?

____

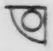


6. The symbol below represents a(an)____.

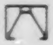


7. What is represented by the symbol illustrated below?

____



8. The symbol below represents a(an)____.



Work Unit 4-5. PLUMBING ABBREVIATIONS

MATCH, FROM A LIST, ANY TWO PLUMBING ABBREVIATIONS TO THEIR CORRECT TERMS.

Plumbing abbreviations. Plumbing plans and details will also have abbreviations. Many times the abbreviation can be identified by the symbol that it is identifying. Table 4-2 shows many of the more commonly used plumbing abbreviations. The builder should become familiar with the basic abbreviations used on plumbing plans and details. Some abbreviations can have more than one meaning or term. Usually the architect will not use the same abbreviation for more than one item on the same floor plan. If the architect does not use the standard abbreviations, he will normally indicate their meanings in a legend or notes section of the plan.

Table 4-2. Plumbing abbreviations

TERM	ABBREVIATION
Area Drain	AD
Bath	B
Bathtub	B or BT
Building Drain	BD
Building Trap	BS
Catch Basin	CB
Cast Iron	CI
Cleanout	CO
Cold Water	CW
Copper	COP
Detail	DET
Dishwasher	DW
Downspout	DS
Drain	D
Drinking Fountain	DF
Fixture	FIX
Floor Drain	FD
Galvanized Iron	GI
Gas	G
Grease Trap	GT
Hose Bibb	HB
Hot Water	HW
Hot Water Return	HWR
Hot Water Tank	HWT
Iron Pipe Size	IPS
Kitchen Sink	KS
Laundry Tray	LT
Laundry Tub	LT
Lavatory	L or LAV
Lawn Faucet	LF
Manhole	MH
Meter	M
Motor	M or MOT
Outside Diameter	OD
Plumbing	PLBG
Plumbing Tube	PT
Rainwater Leader	RWL
Range (Gas)	R
Relief Valve	RV
Roof Drain	RD
Sewer	S
Shower	SH
Sill Cock	SC
Sink	S
Soil Pipe	SP
Soil Stack	SS
Stack	S or STK
Stack Vent	SV
Standpipe	SP
Steam Table	ST
Trap	T
Toilet	T
Tub	T
Urinal	U or UR

Table 4-2. Plumbing abbreviations (continued)

Utility Room	URM
Vent	V
Vent Stack	VS
Vent Through Roof	VTR
Wall Hung	WH
Wall Hydrant	WH
Washer	W
Waste	W
Waste Pipe	WP
Water Closet	WC
Water Heater	WH
Water Softener	WS
Wrought Iron	WI

EXERCISE: Column 1 below lists plumbing plan abbreviations. Column 2 lists plumbing plan terms. In the numbered blanks to the right of the abbreviation, write in the matching term for the abbreviation. Compare your responses with the answers listed at the end of the study unit.

Column 1

ABBREVIATIONS

1. AD, ____________________
2. CI, ____________________
3. CO, ____________________
4. HB, ____________________
5. LAV, ____________________
6. PLBG, ____________________
7. RD, ____________________
8. SH, ____________________
9. UR, ____________________
10. WC, ____________________

Column 2

TERM

Commanding Officer
Catch In
Lavatory
Plumbing
Hose Bibb
Roof Drain
Attic Drain
Waste Catch
Lavender
Shower
Plumbing Tube
Urinal
Area Drain
Cast Iron
Hose Blank
Regular Drain
Sheet
Water Closet
Cleanout
Unit Run

Work Unit 4-6. READING PLUMBING PLANS

IDENTIFY FROM A PLUMBING PLAN, THE SIZE OF THE WATER DISTRIBUTION PIPE.

IDENTIFY FROM A PLUMBING PLAN, THE SIZE OF THE WASTE SYSTEM PIPE.

As mentioned earlier, plumbing is classified as all piping, apparatus, and fixtures for water distribution and waste disposal within a building; therefore, this work unit will focus primarily on these two systems.

From the plumbing plan the builder can determine the location of fixtures and fittings to be installed and the size and routing of piping.

Distribution System Materials. Water distribution piping for interior installations is made of galvanized steel, wrought iron, copper, plastic, or brass. Nickel-, silver-, or chrome-plated piping is used in locations where pipes are exposed to view. Galvanized wrought iron is the material most frequently used in theater of operations construction. Normally, fittings are made of the same material as that used in the piping and are made with screw or flange connections; however, for pipe up to 4 inches in diameter, only screw connections are used. Valves usually are made of brass and may or may not be plated. The material types to be used for the distribution system are designated in the specifications; sizes and special instructions are noted in the drawings.

Waste System Materials. Waste systems include all piping from sinks, water closets, urinals, showers, baths, and other fixtures that carry liquids and sewage outside of the building. A waste system consists of a main drain, branch mains, and soil and vent stacks. Water, soil, and vent piping specifications include the materials of manufacture for each type of piping; cast iron, galvanized steel, wrought iron, copper, brass, lead, or acid-resistant cast-iron pipe. Fittings or traps normally are specified to be of the same material as the pipe.

a. Galvanized steel and iron piping. Galvanized steel and iron pipes and fittings are the materials most commonly specified for waste system plumbing installations. Pipe ends have standard pipe threads and all pipes and fittings of this type are joined by standard pipe threads. Such piping is manufactured in three different weights and in diameters from 1/8-inch to 12 inches to any one of several specifications. The fittings are manufactured in all the shapes required to change or intersect flow.

b. Vitrified clay piping and fittings. Vitrified clay piping and fittings are used for underground house drains and sewers and normally are noted in the plans as VCP or VP. VCP is sometimes used for soil and vent stacks in theater of operations construction. Pipes and fittings are made with bell-and-spigot ends. Joints are made by inserting the spigot end into the bell and caulking with cement mortar.

c. Cast-iron pipes and fittings. Cast-iron pipes and fittings are used for building drains and for soil, waste, and vent piping. These pipes can be laid in unstable soil without danger of sagging. Pipes and fittings are made with bell-and-spigot and flanged ends. Bell-and-spigot joints are caulked with oakum and lead or a caulking compound; flanged fittings are bolted together to make a joint.

d. Brass, lead, and copper piping. Brass, lead, or copper piping is used in high quality, or more expensive systems of waste plumbing. Brass or lead is used when excessive acids or corrosive liquids are present. Such acids or liquids are seldom present in the flow of theater of operations sewerage. Brass pipes and fittings are joined by standard pipe threads, and the fitting shapes are identical to those used for galvanized steel or wrought iron pipe. Lead pipe is very ductile, a feature that is advantageous in speed of installation, but it must be well supported because it deteriorates rapidly if permitted to sag. Copper pipe is not commonly specified for use as waste and vent piping because of the excessive cost of the larger sizes. To make connections, the pipe is cut to the desired length and sweat-soldered to the applicable type of the several fittings available.

Reading plumbing plans. Figure 4-11 is a typical plumbing plan for a bath house and latrine showing the water distribution plumbing, waste plumbing, and electrical wiring. For a small structure of this type, only a plan view as shown will normally be provided together with some additional detail drawings. You can see that the schedule of drawings lists three sources of additional information on the plumbing: a standard details drawing, a special details drawing, and a bill of materials. Standard details are indicated by a number and letter in a circle; for example, 11-G. Special details are called out on the plan, "DETAIL #6" for example. An example of these standard and special details is shown on figure 4-12. Note that the method of supporting the flush tank, the method of coupling the water pipe to the flush tank, and all other necessary information that could not be shown on the plan are clearly shown on the standard drawing for detail 11-G. Also, you can clearly see the required shower head and control valve fitting requirements in special detail #6.

Water Distribution. The plan shown on figure 4-11, along with the standard and special detail drawing and a bill of materials, permits the experienced plumber to install the complete water distribution system accurately and satisfactorily. Note that the hot-water heater and storage tank connections would be detailed on standard detail drawing 11-L. Notice also that the point where the incoming water supply piping would be brought up to ceiling level is shown on the hose bib location standard detail drawing 11-X. Look carefully at the plan and note that the pipe sizes and type are clearly specified in all cases.

Waste System. The plan (fig 4-11) shows the building waste system starting at the 4-inch vents. When standard details are provided, it is important to remember that they are prepared to cover a large variety of applications and the plumber is expected to make minor alterations to suit particular installations. For example: Note that the 90° straight Y in the water closet detail 11-G (fig 4-12) is shown for flow to the left. In the installation plan (fig 4-11), the soil pipe pitch is in the opposite direction so that the Y must be installed in the opposite direction.

Although the waste system shown in the utility plan (fig 4-11) is relatively simple, it does consist of four basic functional elements which are defined as follows:

House Sewer. The house sewer is that part of the waste plumbing system beginning just outside the foundation and terminating at a street sewerage branch or a septic tank. A typical house sewer is shown in section in figure 4-13.

House Drain. The house drain is that part of the waste system which receives the discharge of all soil and waste stacks within the building. It may be installed underground or suspended from the first-floor joists. The house drain system is also referred to as the "collection lines" and includes such appliances as house traps, back-flow valves, cleanouts, and area drains. In general, house drains will fall into one of four classes on any set of specific building plans.

a. Combination system. As shown at the left on figure 4-13, a combination system receives the discharge of the sanitary wastes of the building plus the storm water from the roof and other exterior sources.

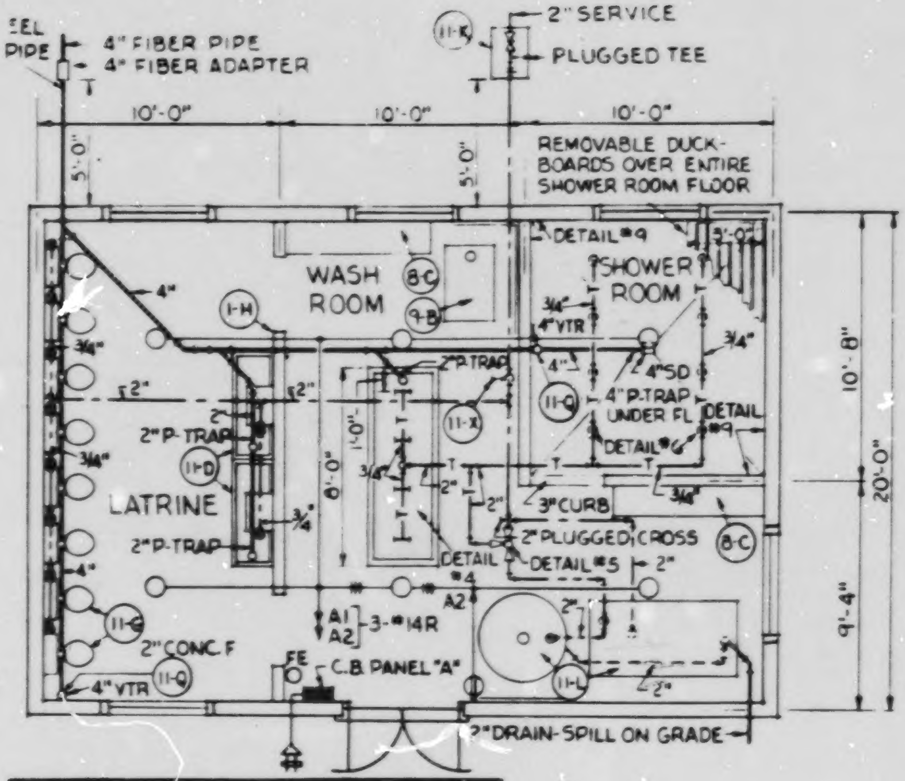
b. Sanitary drain. A sanitary drain receives the discharge of sanitary and domestic wastes only.

c. Storm drain. As shown at the right in figure 3-11, a storm drain receives storm, clear water, or surface-water wastes only.

d. Industrial drain. An industrial drain receives liquid waste from industrial equipment or processes and consequently receives little attention in theater of operations construction.

Soil pipe. Soil pipe is that portion of the plumbing system which receives the discharge of water closets and conveys those wastes to the house drain.

Waste pipe. Waste pipe is that part of the drainage system which conveys the discharge of fixtures other than water closets such as sinks, lavatories, urinals, bathtubs, and similar fixtures to the soil pipe.


4" FIBER PIPE
4" FIBER ADAPTER
2" SERVICE
PLUGGED TEE
11-K
10'-0"
10'-0"
10'-0"
5'-0"
5'-0"
REMOVABLE DUCK-BOARDS OVER ENTIRE SHOWER ROOM FLOOR
DETAIL #9
3'-0"
WASH ROOM
8-C
9-B
1-H
SHOWER ROOM
3/4"
4" VTR
4"
3/4"
2" P-TRAP
4" SD
4" P-TRAP UNDER FL
DETAIL #9
DETAIL #6
11-Q
11-X
10'-8"
20'-0"
9'-4"
2"
2"
2"
2" P-TRAP
3/4"
11-D
LATRINE
3/4
2" P-TRAP
1'-0"
8'-0"
3/4"
2"
2"
3" CURB
3/4"
2" PLUGGED CROSS
8-C
DETAIL #4
DETAIL #5
2"
4"
A1
A2
3-#14R
A2
11-G
2" CONC F
11-Q
4" VTR
FE
C.B. PANEL "A"
11-L
2"
2"
2" DRAIN-SPILL ON GRADE
0
5'
10'
NO. 2

SCHEDULE OF DRAWINGS		
DWG. NO.	DESCRIPTION	SHEET NO.
72-32	PLANS	1 OF 1
72-31	SPECIAL DETAILS	2 OF 3
72-98	STANDARD DETAILS	1 THRU 8
34-91	STD FRAME BARRACKS TYPE BLDG PANEL SCHED	1 OF 2
72-99	BILL OF MATERIALS	3 OF 4

Fig 4-11. Typical plumbing plan for a bath house and latrine.

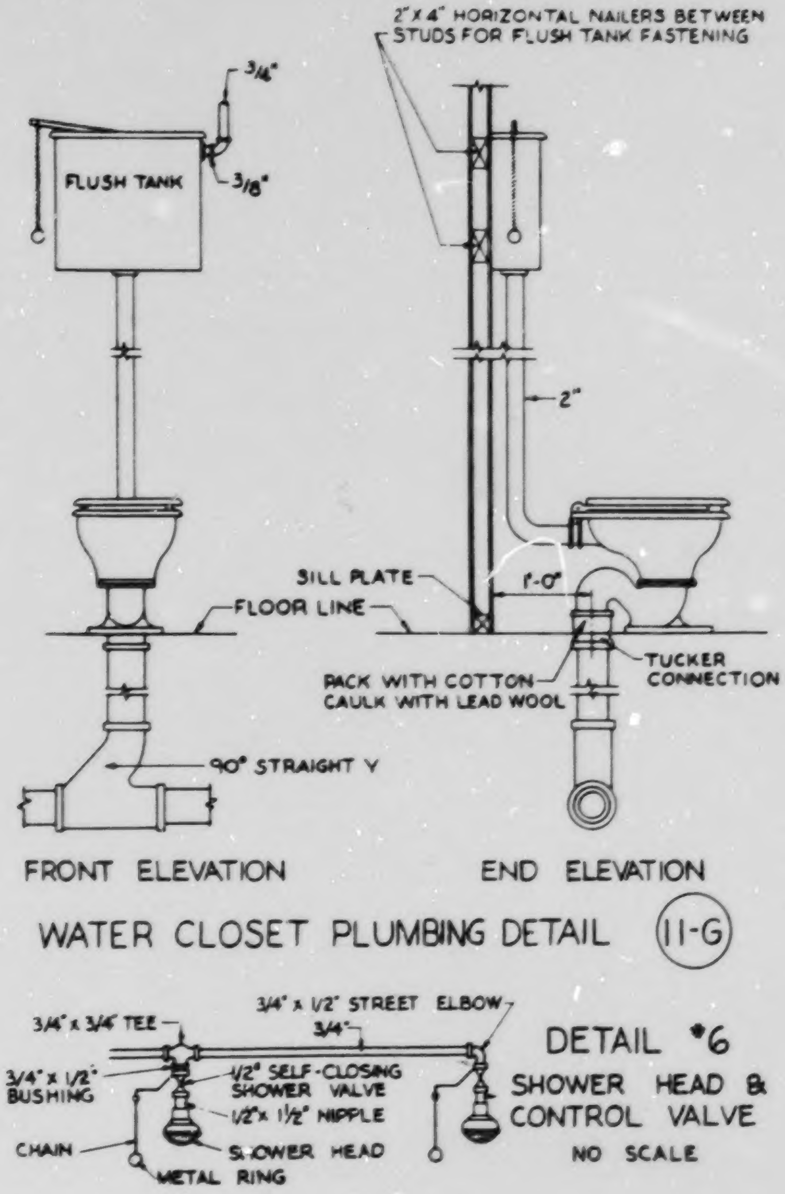

2" X 4" HORIZONTAL NAILERS BETWEEN STUDS FOR FLUSH TANK FASTENING
3/4"
FLUSH TANK
3/8"
2"
SILL PLATE
1'-0"
FLOOR LINE
TUCKER CONNECTION
PACK WITH COTTON
CAULK WITH LEAD WOOL
90° STRAIGHT Y
FRONT ELEVATION
END ELEVATION
WATER CLOSET PLUMBING DETAIL
11-G
3/4" x 1/2" STREET ELBOW
3/4" x 3/4" TEE
3/4"
3/4" x 1/2" BUSHING
1/2" SELF-CLOSING SHOWER VALVE
1/2" x 1 1/2" NIPPLE
CHAIN
SHOWER HEAD
METAL RING
DETAIL *6
SHOWER HEAD & CONTROL VALVE
NO SCALE

Fig 4-12. Typical plumbing details.

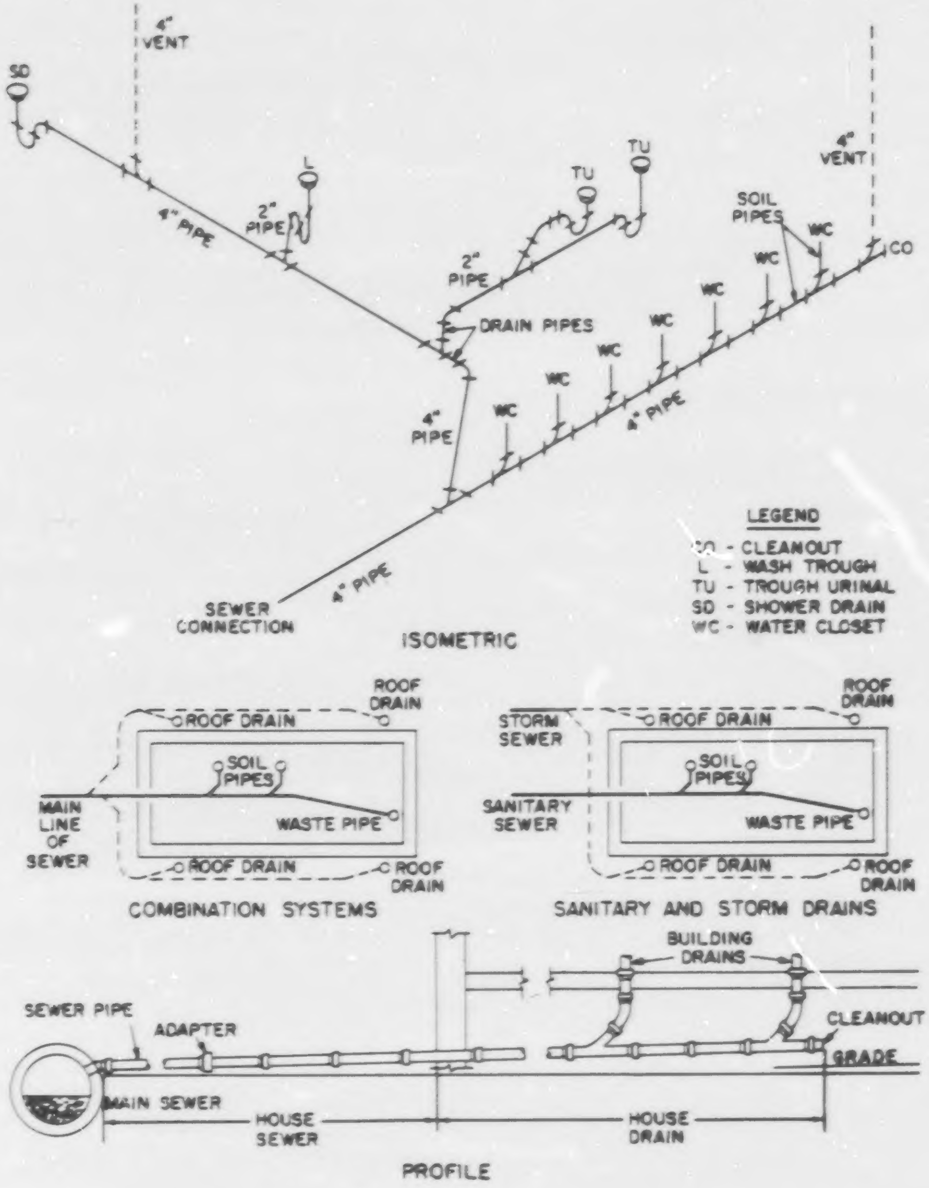

4" VENT
SD
L
2" PIPE
4" PIPE
TU
TU
2" PIPE
DRAIN PIPES
4" VENT
SOIL PIPES
WC
WC
WC
WC
WC
WC
WC
WC
CO
4" PIPE
4" PIPE
4" PIPE
SEWER CONNECTION
LEGEND
CO - CLEANOUT
L - WASH TROUGH
TU - TROUGH URINAL
SD - SHOWER DRAIN
WC - WATER CLOSET
ISOMETRIC
ROOF DRAIN
ROOF DRAIN
SOIL PIPES
MAIN LINE OF SEWER
WASTE PIPE
ROOF DRAIN
ROOF DRAIN
COMBINATION SYSTEMS
STORM SEWER
ROOF DRAIN
ROOF DRAIN
SOIL PIPES
SANITARY SEWER
WASTE PIPE
ROOF DRAIN
ROOF DRAIN
SANITARY AND STORM DRAINS
BUILDING DRAINS
SEWER PIPE
ADAPTER
CLEANOUT
GRADE
MAIN SEWER
HOUSE SEWER
HOUSE DRAIN
PROFILE

Fig 4-13. Typical waste plumbing system.

EXERCISE: Refer to figures 4-11, 4-12, and 4-13 to answer the following questions. Compare your responses with the answers listed at the end of the study unit.

1. What size and type of pipe is used to supply water for the shower heads?

____

2. How many shower heads are to be installed?

____

3. What size cold water pipe is used for the incoming service line?

____

4. What size is the drain in the shower room?

____

5. The building drain system uses 4-inch pipe throughout. (True or False)

____

6. What size is the pipe used as a vent pipe?

____

7. Referring to figure 4-12, detail No. 6, what is used to couple the 3/4-inch Tee to the 1/2-inch self-closing shower valve?

____

Section III. HEATING AND AIR CONDITIONING

Heating is the operation of a system to transmit heat from a point of generation to the place or places of use. The design of heating installations for buildings is one of the more complex fields of construction, and you will find that variations of the basic type of heating systems are numerous. However, this section will cover only two of the most common systems in use, the hot-water and warm-air heating systems.

Air conditioning, as defined by the American Society of Heating and Air Conditioning Engineers, is "the process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space."

You should be familiar with the basic elements of heating and air conditioning systems and their graphic representation if you are to interpret drawings depicting heating and air conditioning systems.

Work Unit 4-7. HEATING AND AIR CONDITIONING SYMBOLS

IDENTIFY, FROM AN ILLUSTRATION, ANY THREE HEATING AND AIR CONDITIONING SYMBOLS.

Heating and air conditioning symbols. Some common symbols that you should be able to identify are shown in figures 4-14 through 4-17. Symbols used to depict ductwork are the same for warm-air heating, ventilating, and air conditioning systems. Items common to heating and air conditioning (such as fan motors and temperature control devices) are depicted with the same symbols on the respective drawings or plans. For example, the symbol for a thermostat as shown in figure 4-14 also applies to air-conditioning.

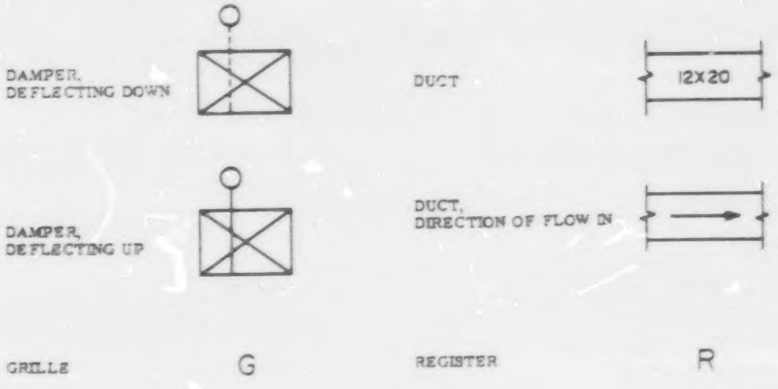


Fig 4-14. Heating symbols.

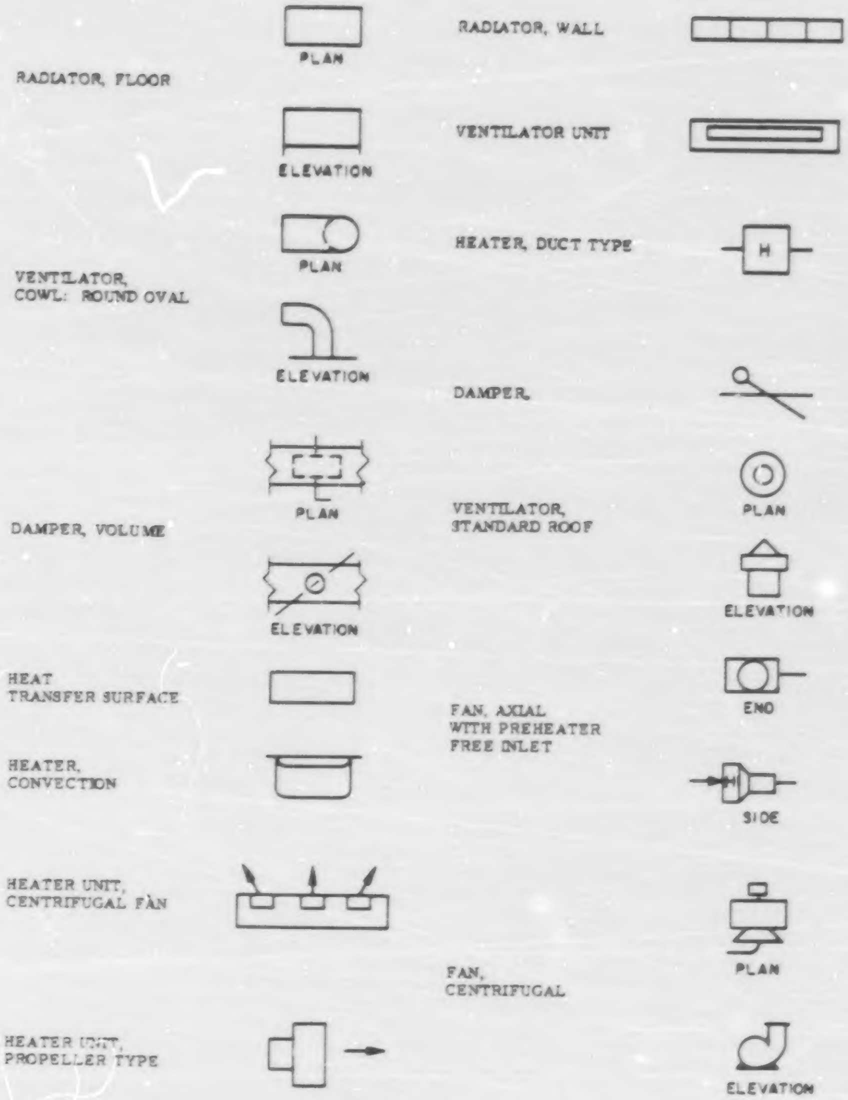

RADIATOR, FLOOR
PLAN
ELEVATION
VENTILATOR,
COWL: ROUND OVAL
PLAN
ELEVATION
DAMPER, VOLUME
PLAN
ELEVATION
HEAT
TRANSFER SURFACE
HEATER,
CONVECTION
HEATER UNIT,
CENTRIFUGAL FAN
HEATER UNIT,
PROPELLER TYPE
RADIATOR, WALL
VENTILATOR UNIT
HEATER, DUCT TYPE
H
DAMPER
VENTILATOR,
STANDARD ROOF
PLAN
ELEVATION
FAN, AXIAL
WITH PREHEATER
FREE INLET
END
SIDE
FAN,
CENTRIFUGAL
PLAN
ELEVATION

Fig 4-14. Heating symbols--(continued).

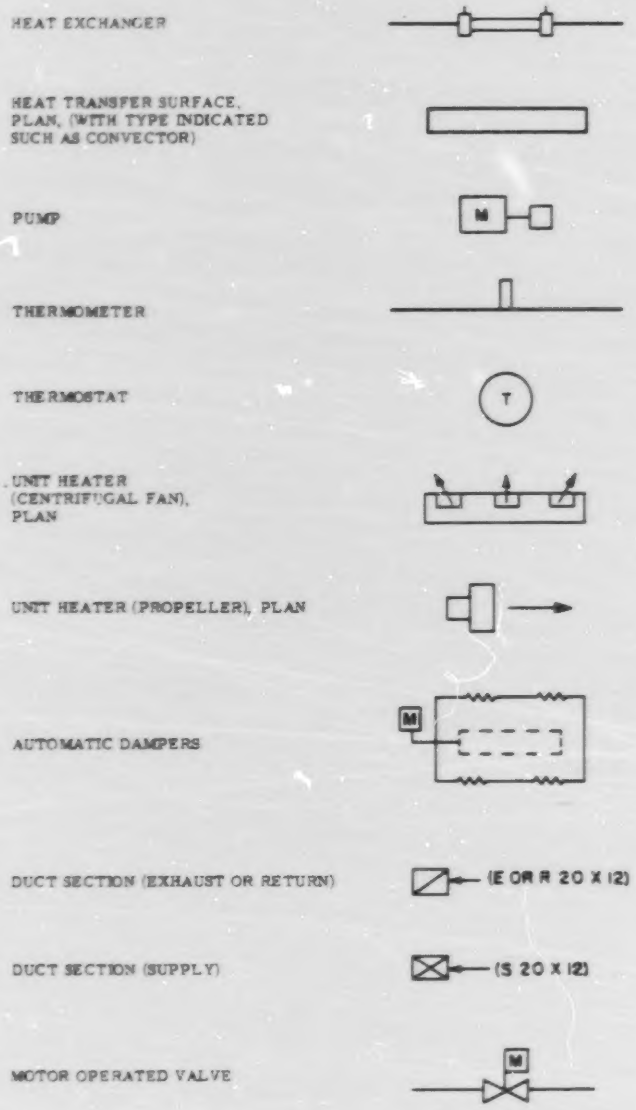

HEAT EXCHANGER
HEAT TRANSFER SURFACE, PLAN, (WITH TYPE INDICATED SUCH AS CONVECTOR)
PUMP
M
THERMOMETER
THERMOSTAT
T
UNIT HEATER (CENTRIFUGAL FAN), PLAN
UNIT HEATER (PROPELLER), PLAN
AUTOMATIC DAMPERS
M
DUCT SECTION (EXHAUST OR RETURN)
(E OR R 20 X 12)
DUCT SECTION (SUPPLY)
(S 20 X 12)
MOTOR OPERATED VALVE
M

Fig 4-14. Heating symbols--(continued).

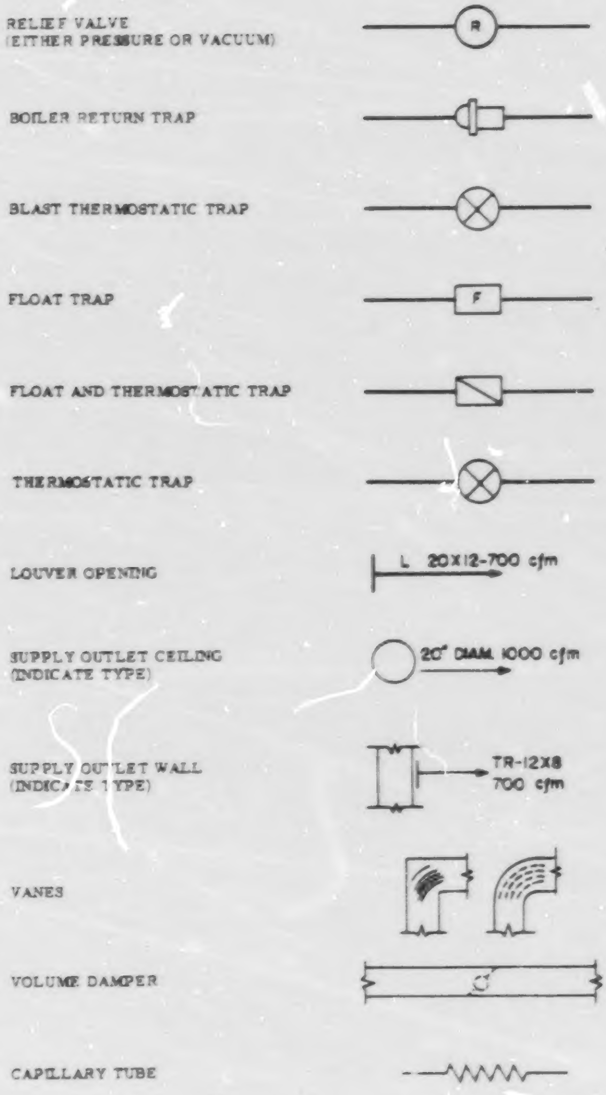

RELIEF VALVE
(EITHER PRESSURE OR VACUUM)
R
BOILER RETURN TRAP
BLAST THERMOSTATIC TRAP
FLOAT TRAP
F
FLOAT AND THERMOSTATIC TRAP
THERMOSTATIC TRAP
LOUVER OPENING
L 20X12-700 cfm
SUPPLY OUTLET CEILING
(INDICATE TYPE)
20" DIAM. 1000 cfm
SUPPLY OUTLET WALL
(INDICATE TYPE)
TR-12X8
700 cfm
VANES
VOLUME DAMPER
CAPILLARY TUBE

Fig 4-14. Heating symbols--(continued).

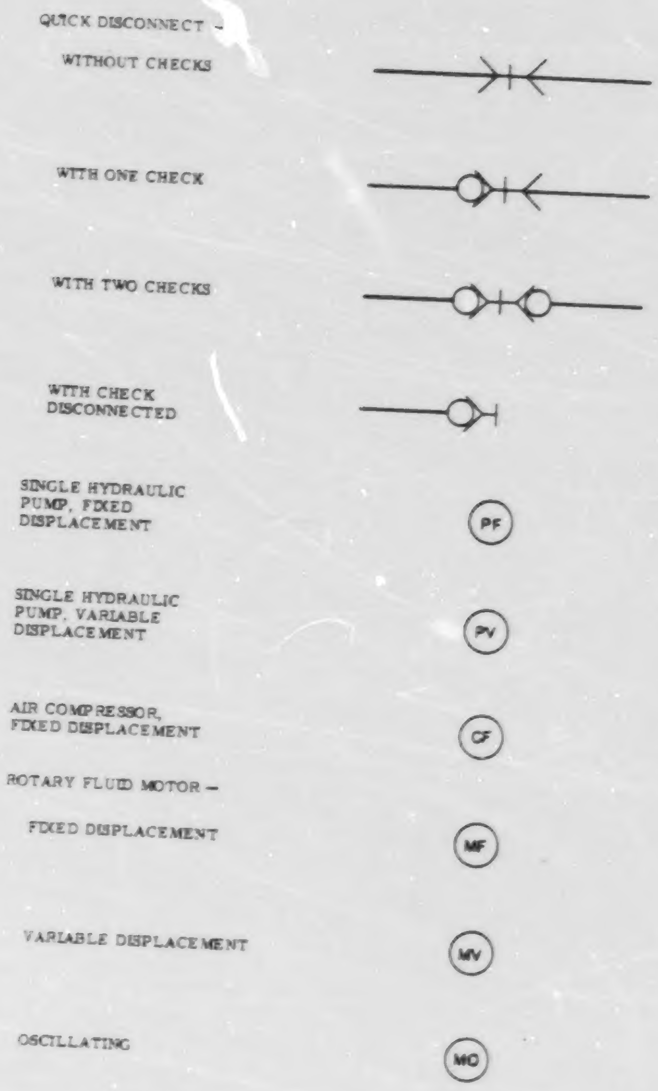

QUICK DISCONNECT -
WITHOUT CHECKS
WITH ONE CHECK
WITH TWO CHECKS
WITH CHECK DISCONNECTED
SINGLE HYDRAULIC PUMP, FIXED DISPLACEMENT
PF
SINGLE HYDRAULIC PUMP, VARIABLE DISPLACEMENT
PV
AIR COMPRESSOR, FIXED DISPLACEMENT
CF
ROTARY FLUID MOTOR -
FIXED DISPLACEMENT
MF
VARIABLE DISPLACEMENT
MV
OSCILLATING
MO

Fig 4-14. Heating symbols--(continued).

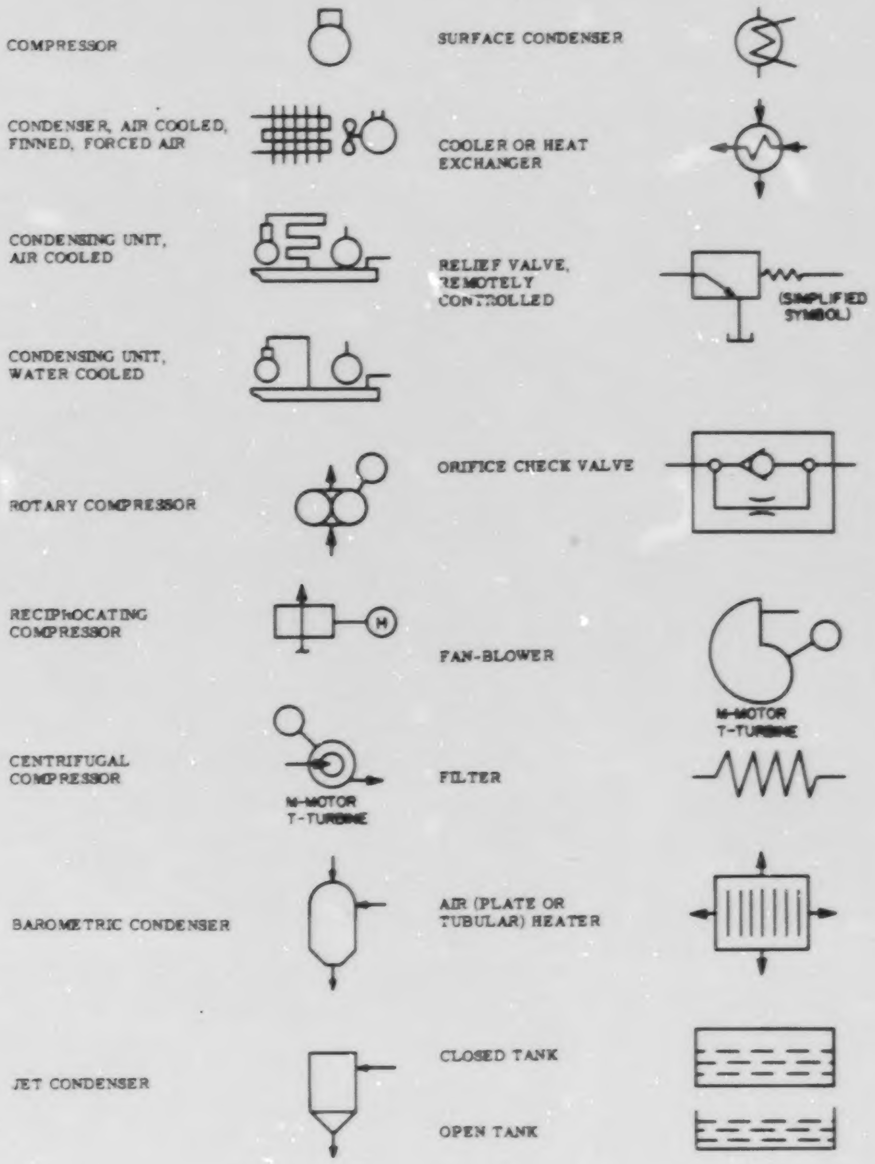

COMPRESSOR
SURFACE CONDENSER
CONDENSER, AIR COOLED, FINNED, FORCED AIR
COOLER OR HEAT EXCHANGER
CONDENSING UNIT, AIR COOLED
RELIEF VALVE, REMOTELY CONTROLLED
(SIMPLIFIED SYMBOL)
CONDENSING UNIT, WATER COOLED
ORIFICE CHECK VALVE
ROTARY COMPRESSOR
RECIPROCATING COMPRESSOR
M
FAN-BLOWER
M-MOTOR
T-TURBINE
CENTRIFUGAL COMPRESSOR
M-MOTOR
T-TURBINE
FILTER
BAROMETRIC CONDENSER
AIR (PLATE OR TUBULAR) HEATER
JET CONDENSER
CLOSED TANK
OPEN TANK

Fig 4-14. Heating symbols--(continued).

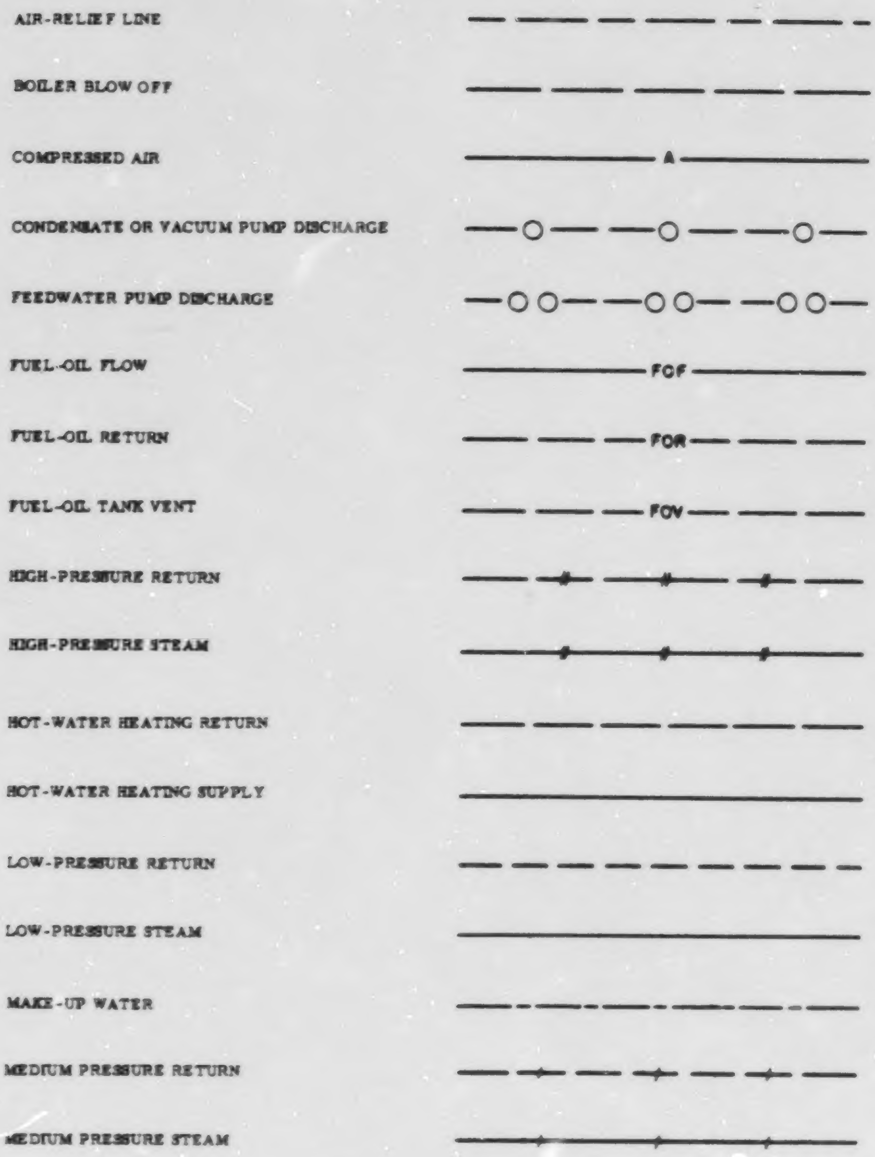

AIR-RELIEF LINE
BOILER BLOW OFF
COMPRESSED AIR
A
CONDENSATE OR VACUUM PUMP DISCHARGE
FEEDWATER PUMP DISCHARGE
FUEL-OIL FLOW
FOF
FUEL-OIL RETURN
FOR
FUEL-OIL TANK VENT
FOV
HIGH-PRESSURE RETURN
HIGH-PRESSURE STEAM
HOT-WATER HEATING RETURN
HOT-WATER HEATING SUPPLY
LOW-PRESSURE RETURN
LOW-PRESSURE STEAM
MAKE-UP WATER
MEDIUM PRESSURE RETURN
MEDIUM PRESSURE STEAM

Fig 4-15. Heating piping symbols.

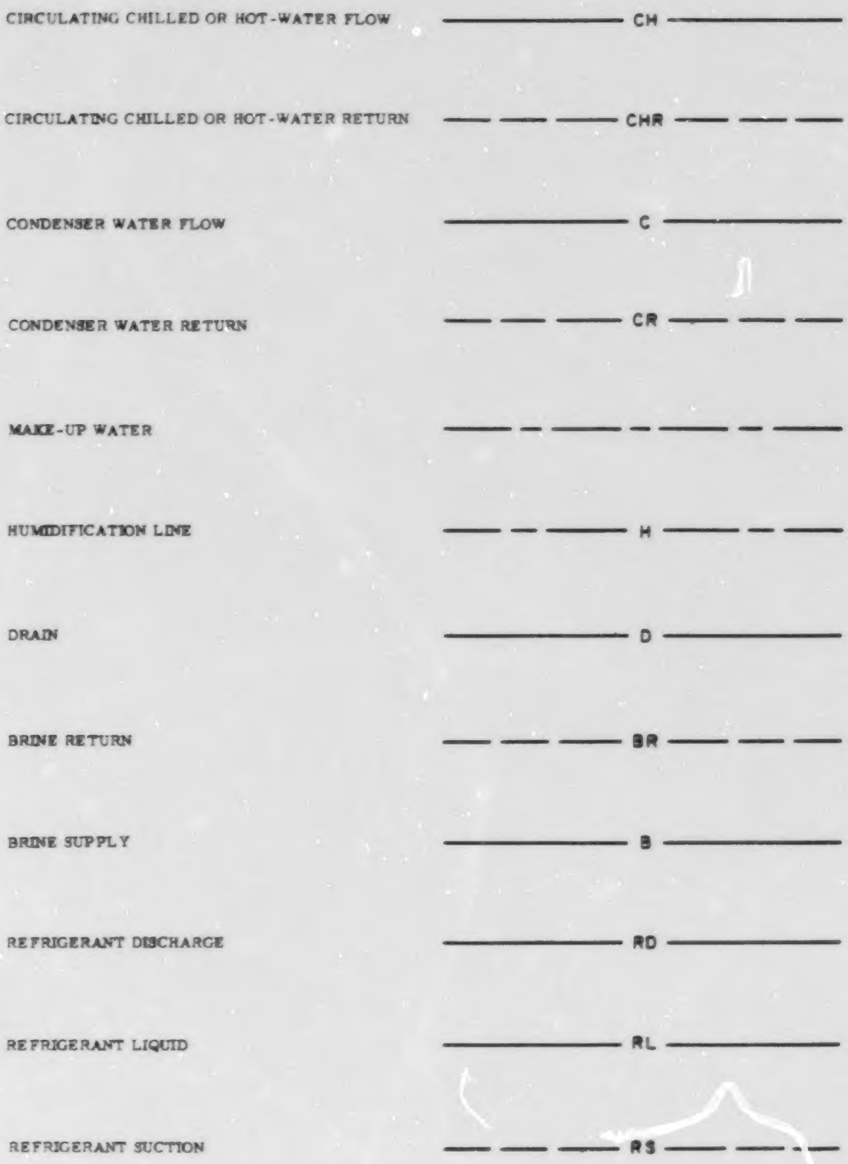

CIRCULATING CHILLED OR HOT-WATER FLOW
CH
CIRCULATING CHILLED OR HOT-WATER RETURN
CHR
CONDENSER WATER FLOW
C
CONDENSER WATER RETURN
CR
MAKE-UP WATER
HUMIDIFICATION LINE
H
DRAIN
D
BRINE RETURN
BR
BRINE SUPPLY
B
REFRIGERANT DISCHARGE
RD
REFRIGERANT LIQUID
RL
REFRIGERANT SUCTION
RS

Fig 4-16. Air conditioning piping symbols.

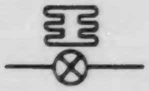
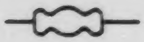
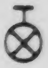
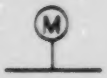
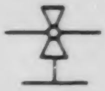
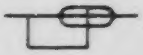
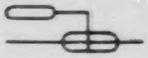
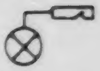
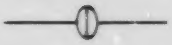
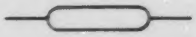
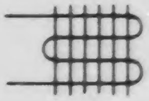
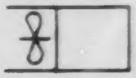
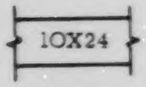
WATER VALVE	
LINE VIBRATION ABSORBER	
HAND EXPANSION VALVE	
MAGNETIC STOP VALVE	
SNAP ACTION VALVE	
SUCTION VAPOR REGULATING VALVE	
THERMO SUCTION VALVE	
THERMOSTATIC EXPANSION VALVE	
LINE FILTER	
LINE FILTER & STRAINER	
NATURAL CONVECTION FINNED-TYPE COOLING UNIT	
FORCED CONVECTION COOLING UNIT	

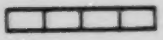
Fig 4-17. Air conditioning symbols.

EXERCISE: Answer the following questions and compare your responses with the answers listed at the end of the study unit.

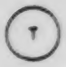
1. What is represented by the symbol illustrated below?



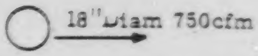
2. The illustration below is an illustration of a(an)



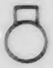
3. What symbol is illustrated below?



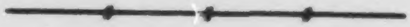
4. What is represented by the symbol illustrated below?



5. What symbol is illustrated below?

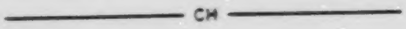


6. What type of heating pipe symbol is illustrated below?

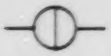


7. What type of air conditioning pipe symbol is illustrated below?

____

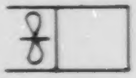


8. The illustration below is the symbol for______________________________



9. What symbol is illustrated below?

____



Work Unit 4-8. HEATING AND AIR CONDITIONING ABBREVIATIONS.

MATCH, FROM A LIST, ANY THREE HEATING AND AIR CONDITIONING ABBREVIATIONS TO THEIR CORRECT TERMS.

Heating and air conditioning abbreviations. Table 4-3 shows some of the more common abbreviations found on heating and air conditioning plans. As a builder, you should become familiar with the basic abbreviations used on heating and air conditioning plans. Note that some abbreviations can have more than one meaning. If the architect does not use the standard abbreviations on a plan, he will usually note these (or all abbreviations) in a legend or notes sections.

Table 4-3. Heating and air conditioning abbreviations

TERM	ABBREVIATION
Air Conditioning	AC or AIR COND
Branch	B or BR
British Thermal Units Per Hour	BTU/H
Ceiling	CLG
Cellar	CEL
Cold Air	CA
Cold Air Return	CAR
Cold Water	CW
Connection	CONN
Convector	CONV
Detail	DET
Diagram	DIAG
Diameter	D,DIA, or DIAM
Diffuser	D
Dimension	DIM
Exhaust	EXH
Exhaust Register	ER
Floor	FLR
Floor Mounted	FM
Forced Air	FA
Furnace	FURN
Gas	G
Grill	G

Table 4-3. Heating and air conditioning abbreviations--continued

TERM	ABBREVIATION
Heater	HTR
Hot Air	HA
Hot Water	HW
Hot Water Return	HWR or HR
Main	M
Maximum	MAX
Motor	M or MOT
Outside Air	OA
Prefabricated	PREFAB
Radiator	RAD
Register	REG
Return	R or RET
Return Air	RA
Return Grille	RG
Return Register	RR
Riser	R
Steam	S
Supply Air	SA
Thermostat	T or THERMO
Vent	V
Vent Piping	VP
Ventilator	V
Warm Air	WA
Warm Air Return	WAR

EXERCISE: The column I below lists heating and air conditioning plan abbreviations. Column II lists heating and air conditioning plan terms. In the numbered blanks to the right of the abbreviations write the matching term for the abbreviation. Compare your responses with the answers listed at the end of the study unit.

Column I

ABBREVIATIONS

1. AC, ______________
2. CA, ______________
3. DIA, ______________
4. EXH, ______________
5. FA, ______________
6. SA, ______________
7. REG, ______________
8. HW, ______________
9. HA, ______________
10. S, ______________

Column II

TERMS

Steam
High Wall
Supply Air
Register
Air conditioning
Funnelled Air
Safety Activator
Cold Air
Diagram
Slate
Hatch
Hot Water
Air Cooled
Forced Air
Exterior
Regular
Cool Air
Hot Air
Exhaust
Diameter

Work Unit 4-9. HOT-WATER HEATING PLANS

NAME THE TWO TYPES OF HOT-WATER HEATING SYSTEMS.

IDENTIFY, FROM A DIAGRAM, A ONE-PIPE HOT-WATER HEATING SYSTEM.

IDENTIFY, FROM A DIAGRAM, A TWO-PIPE HOT-WATER HEATING SYSTEM.

Heating systems are classified according to the medium used to carry heat from the point of generation to the point of use. Steam or hot-water and warm-air systems are the most commonly used. Hot-water heating is used extensively. Warm-air heating is probably the most familiar to you because it is used in almost all semi-permanent construction and in most barracks. Hot-water heating systems will be discussed in this work unit, and warm-air heating systems in the next work unit.

Hot-water heating systems. Circulation of water which has been heated at a central source through pipes to radiators or convectors and back to the heating unit describes a hot-water heating system. Usually, you will find that a pump is used to keep the water circulating; gravity systems are seldom used. There are two classes of hot-water systems: the one-pipe system and the two-pipe system.

One-pipe System. The one-pipe system (fig 4-18) is the simplest type of hot water installation. Hot water circulates through a single main and through each radiator in turn. The water that reaches the last radiator will be cooler than the water in the first. To obtain the same amount of heat from each radiator, the next radiator must be larger than the one before, and the last one should be the largest of all. It is apparent that the one-pipe system is adequate for very small installations only.

Two-pipe System. You will find that the disadvantages of the one-pipe system are largely offset by the two-pipe system. Figure 4-19 shows a two-pipe hot-water heating system. The hot water from the heater unit goes directly to the five radiators via the main, tees, and elbows. The cooler water leaving the radiators goes back to the heater unit via separate return piping, elbows, and tees.

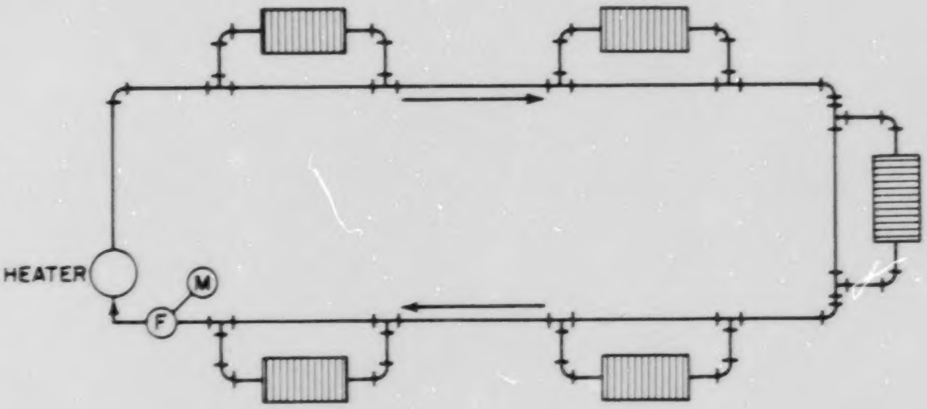


Fig 4-18. One-pipe hot-water heating system diagram.

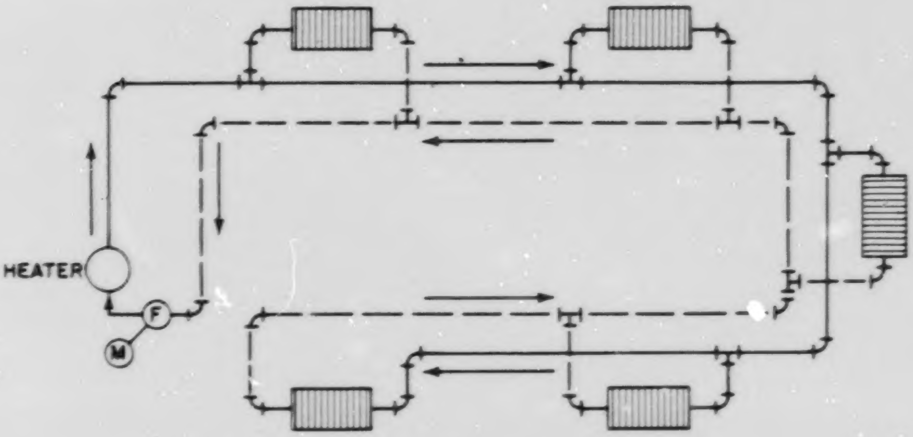


Fig 4-19. Two-pipe hot-water heating system diagram.

Hot-Water Heating System Plans. You may find a separate plan for the hot-water heating system or you may find that the plan of the heating system is incorporated with the hot and cold water and sewer lines on the plumbing plan. A plan of a hot-water heating system shows you the layout of the units, piping, accessories, and connections. A typical hot-water heating system plan is illustrated in figure 4-20. (Figure 4-20 also shows electrical utility, which you may disregard in this discussion.) You can see that the location of the boiler, circulating pump, and compression tank are noted. Follow the supply piping from the boiler and you can see that the one-pipe system is used; however, the hot water will flow in two directions or loops. Each loop contains two radiators. The second radiator in each loop is larger than the first. The plan also notes that the piping is 1 inch and is located in the crawl space.

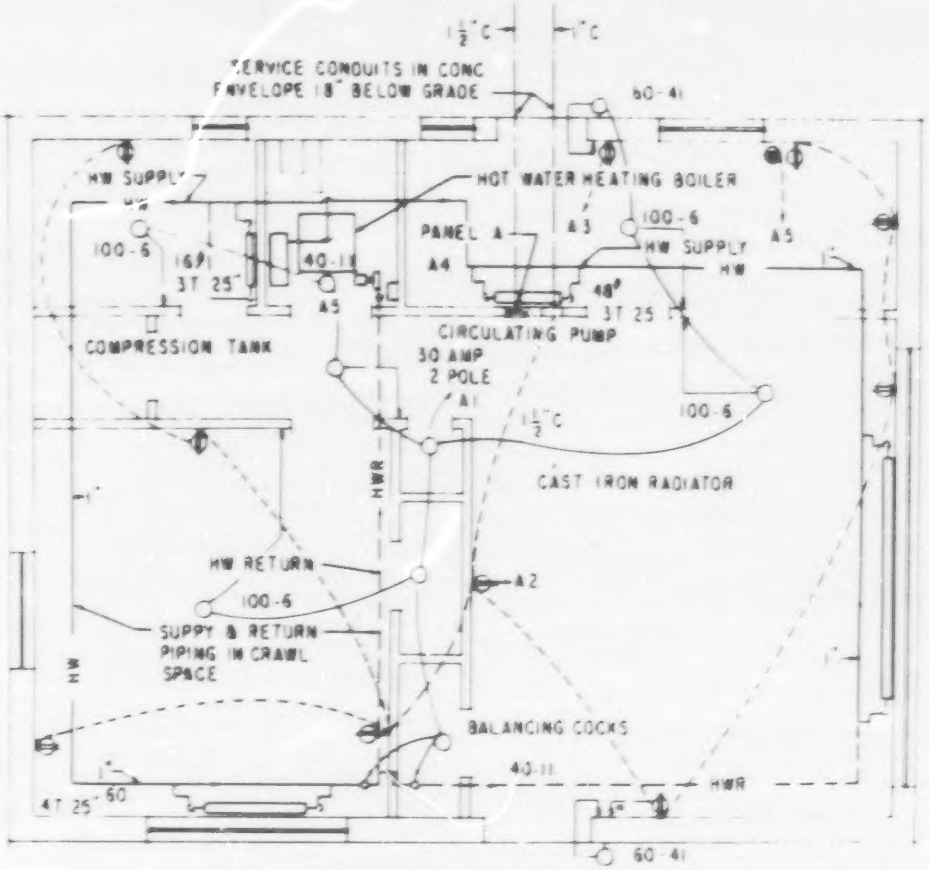

1½"C
1"C
SERVICE CONDUITS IN CONC
ENVELOPE 18" BELOW GRADE
60-41
HW SUPPLY
HW
HOT WATER HEATING BOILER
100-6
16 ⅞
3T 25"
40-11
A5
PANEL A
A3
A4
100-6
HW SUPPLY
HW
A5
1"
48"
3T 25
COMPRESSION TANK
CIRCULATING PUMP
30 AMP
2 POLE
A1
1½"C
100-6
CAST IRON RADIATOR
1"
HWR
HW RETURN
100-6
A2
SUPPY & RETURN
PIPING IN CRAWL
SPACE
HW
1"
BALANCING COCKS
40-11
HWR
1"
4T 25"
60
60-41

Fig 4-20. Typical hot-water heating system plan.

EXERCISE: Answer the following questions and compare your responses with the answers listed at the end of the study unit.

1. The two types of hot-water heating systems are the ____________ system and the ____________ system.

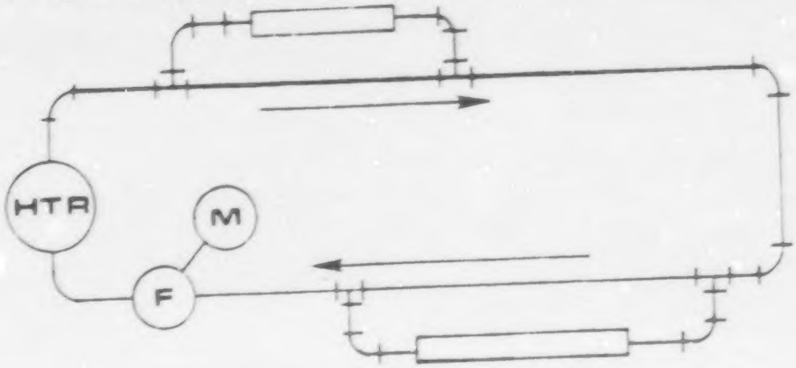
2. Which hot-water heating system circulates hot water through a single main and through each radiator in turn?

   ____

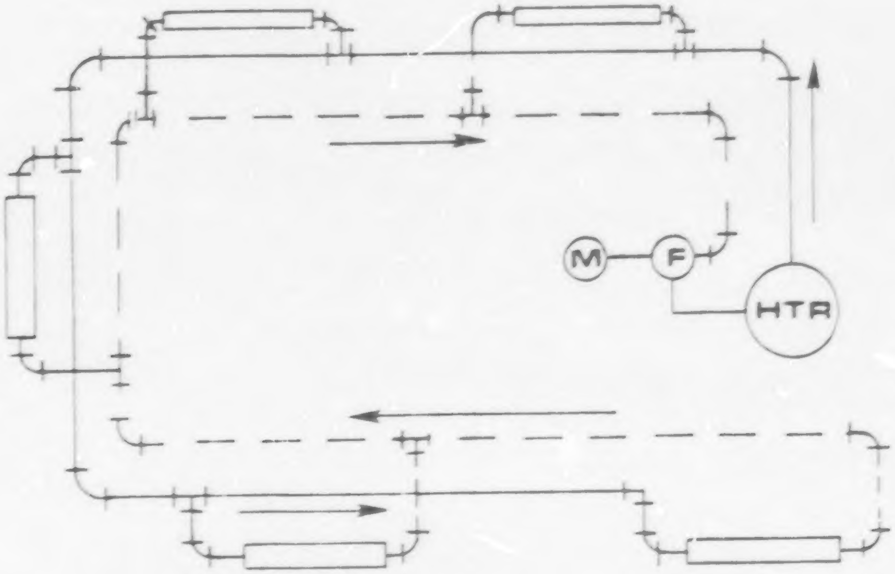
3. Which hot-water heating system supplies hot water to the radiators on one pipe and returns the cooler water to the heater on a separate pipe?

   ____

4. The diagram illustrated is an example of a ____________ heating system.



5. The diagram illustrated is an example of a ________ heating system.



Work Unit 4-10. WARM-AIR HEATING PLANS

DEFINE COMFORT ZONE.

IDENTIFY, FROM A WARM-AIR HEATING PLAN, THE SIZE OF ANY SUPPLY DUCT.

IDENTIFY, FROM A WARM-AIR HEATING PLAN, THE SIZE OF ANY RETURN DUCT.

Distribution of heated air through a duct system describes a warm-air heating system. Usually, gas-fired or oil-fired furnaces are used to heat the air, but you may also heat air by passing the air through steam- or water-heated coils.

Typical Warm-Air System. A warm-air heating system consists of a furnace, a bonnet, warm-air supply ducts and registers, return (cold) air registers and ducts, and a fan or blower for forced circulation. A warm-air heating system is shown in figure 4-21. Note the bonnet above the heat plant where the heated air is collected for distribution to the various rooms. The warm air is distributed from the bonnet through the supply ducts and discharged into the room through registers or grills. You can see that the ducts are rectangular in shape and that the warm-air register is installed in the ceiling. (Some other systems might have round ducts and warm-up registers in the wall.) The air, after circulating through the room and losing heat, is returned to the heat plant via the cold-air return registers and ducts. The return air register is placed in the wall just below the window, and the return air duct is installed in the crawl space. The warm-air distribution via the branch ducts to the other rooms of the building would be the same as the examples.

Design Principles. The comfort zone concept is the basis for all heating designs. The comfort zone is defined as the horizontal area from the top of an average man's head to his knees. It is apparent that if the air from the supply-registers were blown directly on a person, he would be very uncomfortable. To avoid this, the registers are placed either above or below the comfort zone; i.e., high on the wall or in the baseboard. Warm-air systems are laid out so that the warm air from the registers is directed at the cold exterior walls. Therefore the warm-air registers are placed on interior walls or ceilings. The registers for the cold air return are always located at baseboard height. The reason for this location is probably obvious; cold air is heavy and collects at the floor level of the room, thus the registers located in the baseboard collect the air. The cold air is motivated through the return ducts to the furnace for reheating and recirculation. The furnace location is also important for proper warm-air heating. It is good design policy to locate the furnace room centrally in the building plan to equalize duct lengths. In addition, the main (trunk) ducts should run above a central corridor to equalize the branch duct lengths to the individual rooms. See figure 4-22 for illustrations of some of the common rectangular-duct connections. Illustration 1 is a typical warm-air bonnet with two main supply ducts.

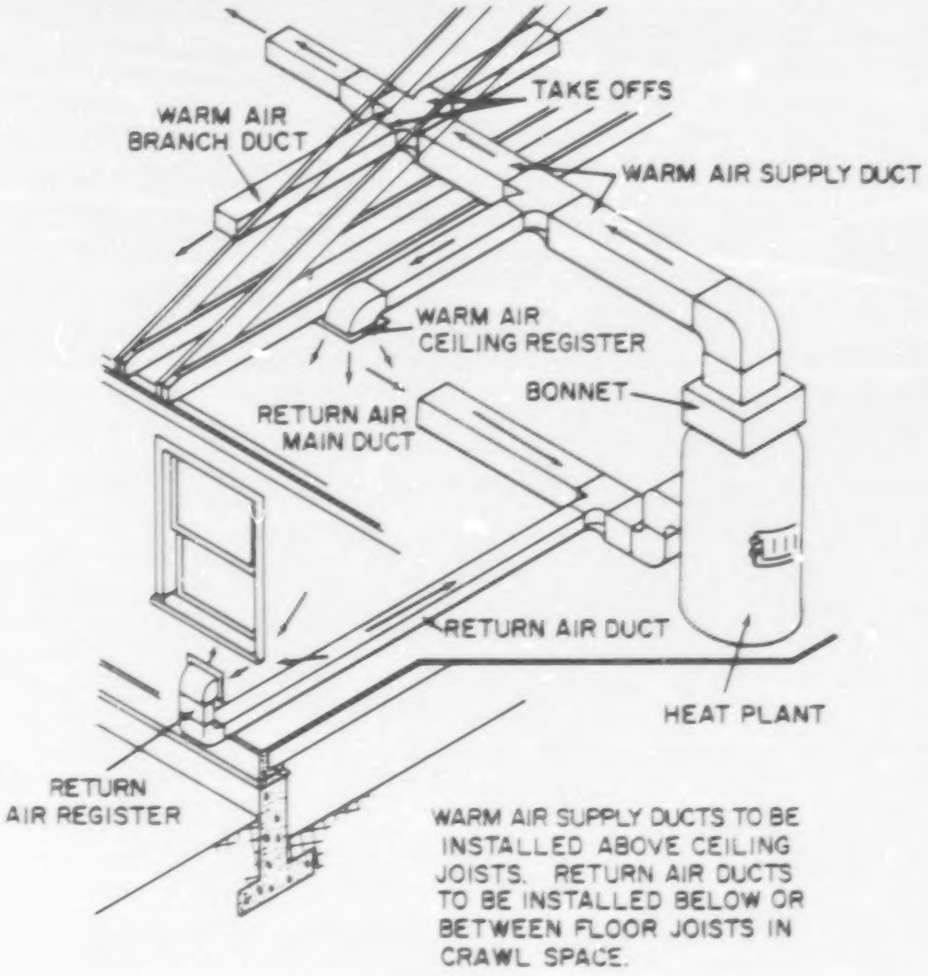
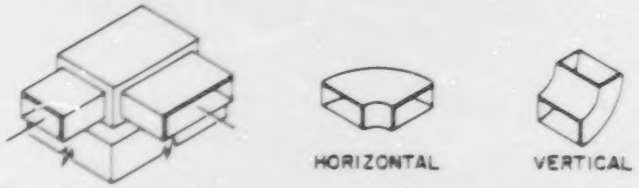

TAKE OFFS
WARM AIR BRANCH DUCT
WARM AIR SUPPLY DUCT
WARM AIR CEILING REGISTER
BONNET
RETURN AIR MAIN DUCT
RETURN AIR DUCT
HEAT PLANT
RETURN AIR REGISTER
WARM AIR SUPPLY DUCTS TO BE INSTALLED ABOVE CEILING JOISTS. RETURN AIR DUCTS TO BE INSTALLED BELOW OR BETWEEN FLOOR JOISTS IN CRAWL SPACE.

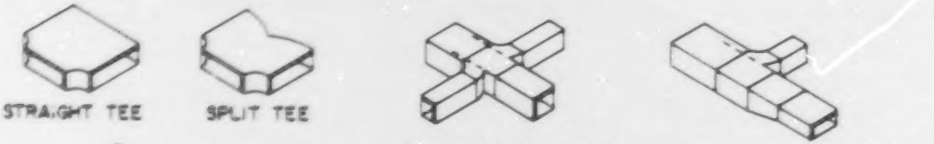
Fig 4-21. Warm-air heating system.

Two possible elbow connections are shown in 2. The split tee in 3 is used to direct the flow of air on the warm side of the system. On the cold air return, the straight tee in 3 may be used. Trunk duct takeoffs are shown in 4 and 5. In the double branch connection, less air is present in the main duct after some of the air has been channeled into branch ducts; therefore, the size can be reduced after the connection. The single branch connection shows two methods of reduction. The first occurs at the connection in a horizontal direction; the second is effected by a vertical reduction in depth. In both double and single branch takeoffs, the branch connections form a natural air scoop to encourage airflow in the desired direction. A boot fitting from branch to stack, the stack terminating at a warm-air register, is illustrated in 6, figure 4-22.

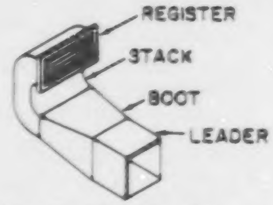
Using a boot is one method of changing its equivalent cross section area or constricting the flow of air.



① WARM-AIR BONNET ② DUCT ELBOWS



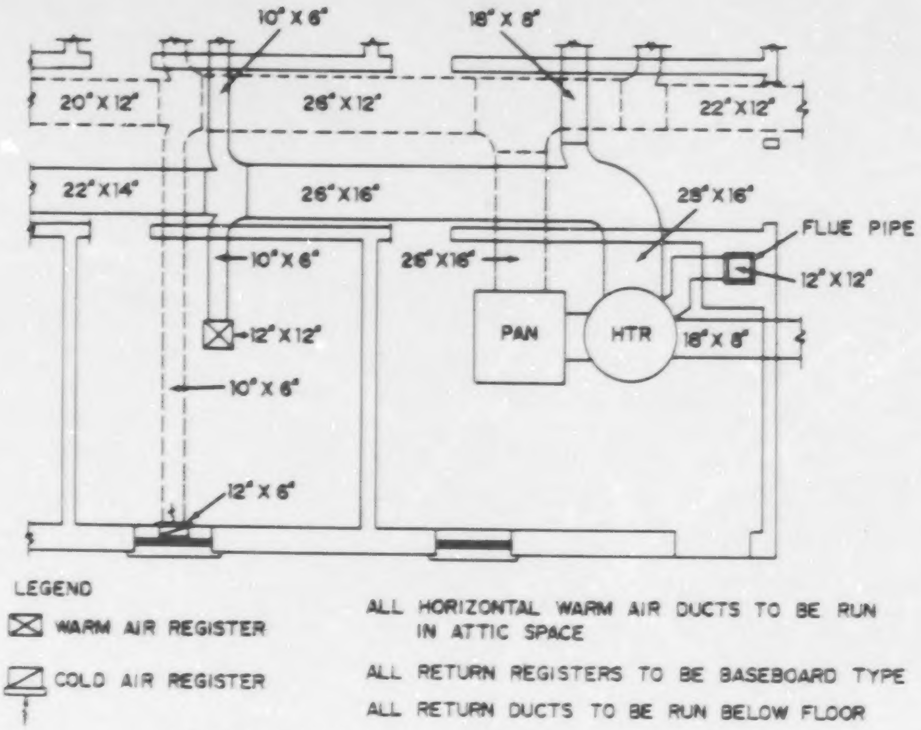
③ DUCT TEES ④ DOUBLE BRANCH ⑤ SINGLE BRANCH WITH MAIN DUCT REDUCTION



⑥ BOOT FITTING FROM BRANCH TO STACK

Fig 4-22. Duct connections.

Warm-Air Heating System Plans. Warm-air ducts are indicated in the heating plan by solid lines. Cold-air return ducts are indicated by dash-lines. See figure 4-23. Note that all the duct sizes are given and are shown with the horizontal or width dimension listed first. The second dimension represents the depth of the duct which is not shown. On the plan, you can locate the warm-air registers and obtain the sizes. When ceiling registers (diffusers) are used, the neck dimensions are shown on the plan (as in figure 4-23). When wall or baseboard registers are used, the face dimensions are given. The height of the wall registers above the finished floor line would be given to you in the notes on the plan. Cold-air return registers are shown recessed into the wall. The face dimensions of the return register are noted adjacent to the symbol.



10" X 6"
18" X 8"
20" X 12"
26" X 12"
22" X 12"
22" X 14"
26" X 16"
28" X 16"
FLUE PIPE
10" X 6"
26" X 16"
12" X 12"
12" X 12"
PAN
HTR
18" X 8"
10" X 6"
12" X 6"
LEGEND
WARM AIR REGISTER
COLD AIR REGISTER
ALL HORIZONTAL WARM AIR DUCTS TO BE RUN IN ATTIC SPACE
ALL RETURN REGISTERS TO BE BASEBOARD TYPE
ALL RETURN DUCTS TO BE RUN BELOW FLOOR

Fig 4-23. Typical warm-air heating system plan.

EXERCISE: Answer the following questions and compare your responses with the answers listed at the end of the study unit. Questions 2 through 6 refer to figure 4-23.

1. The comfort zone is the horizontal area from the top of an average man's head to his ____________.

2. What are the dimensions of the warm air register shown in figure 4-23?

   ____

3. Referring to figure 4-23, what is the size of the supply duct branch connected to the warm-air register?

   ____

4. What are the dimensions of the cold air register shown in figure 4-23?

   ____

5. What is the size of the return duct branch from the cold-air register shown in figure 4-23?

   ____

6. What is the largest size supply duct required in the warm-air heating system shown in figure 4-23?

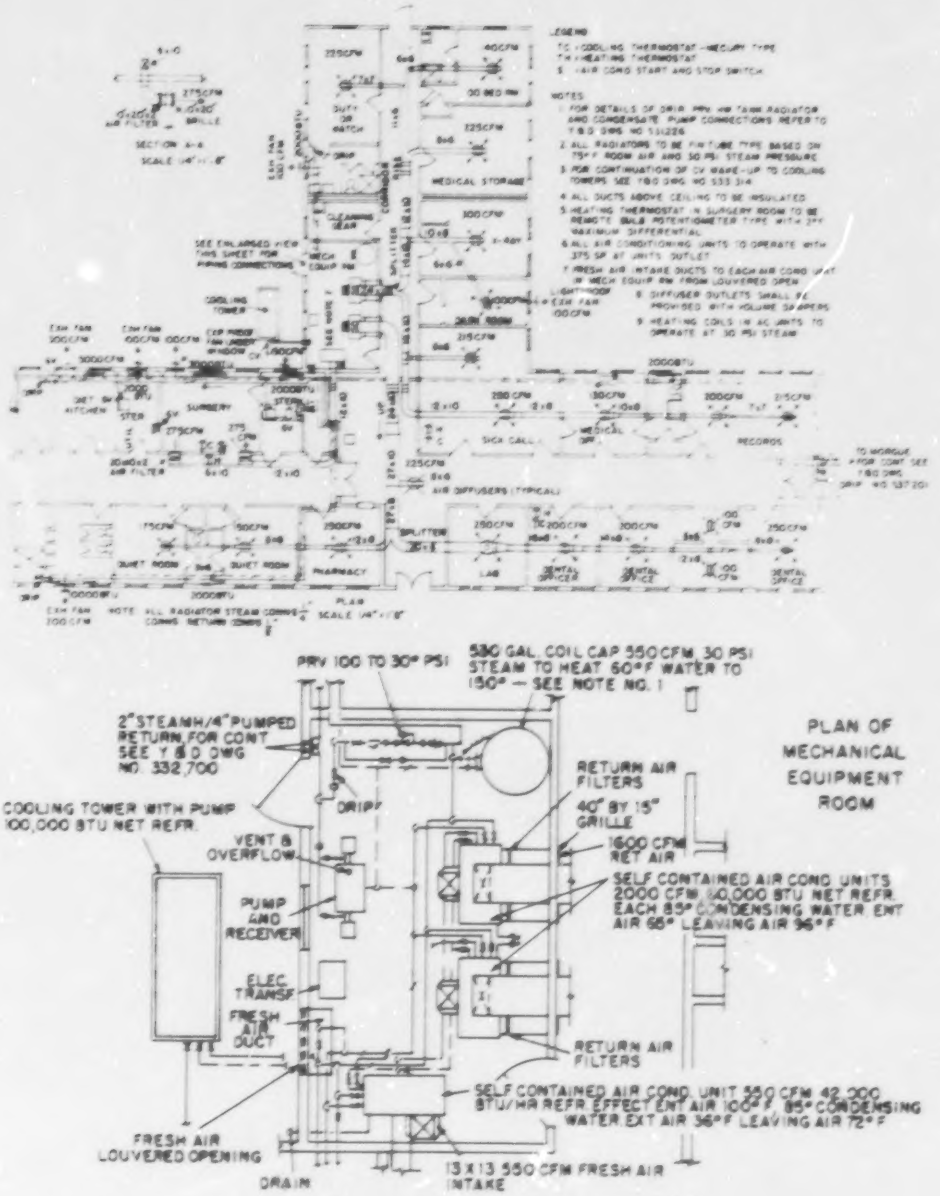
   ____

Work Unit 4-11. AIR CONDITIONING PLANS

IDENTIFY, FROM AN AIR CONDITIONING PLAN, THE RATE OF AIR SUPPLY TO ANY LOCATION.

An air-conditioning system comprises several distinct units, each designed to perform a specific function. The system may be divided into three functional subsystems: refrigerant, control, and air path. Refrigeration will not be covered in this course. The control subsystem consists of the compressor motor, fan motor, starting and running circuit, relay, pressure or temperature control switch, and thermostat. It is the air path that is of prime interest to you when reading construction prints. This includes the ductwork, grills, dampers, and screens.

Air-conditioning plans. A plan of heating and air-conditioning systems for a hospital is shown in figure 4-24. You should disregard, for this discussion, everything on figure 4-24 that does not relate to the air-conditioning system. The plan indicates three self-contained air-conditioning units which are located in the mechanical equipment room. Note that the ductwork from the two main units is split and the size of the ducts reduced. The plan also shows you the amount of air each diffuser will supply. For example, the supply to the lab is rated at 250 cfm while the one from the dark room is rated at 100 cfm. As you can see, the third air-conditioning unit supplies the surgery room only. The enlarged plan view of the mechanical equipment room shows you the piping connections. This piping is read in the same manner as you would read the piping on a hot-water plan. For example, note the condenser water flow (c) to the three air-conditioning units.



LEGEND
TC COOLING THERMOSTAT - MERCURY TYPE
TH HEATING THERMOSTAT
S AIR COND START AND STOP SWITCH
NOTES
1 FOR DETAILS OF DRIP, PRV, HW TANK RADIATOR AND CONDENSATE PUMP CONNECTIONS REFER TO Y & D DWG NO 531226
2 ALL RADIATORS TO BE FIN TUBE TYPE BASED ON 75° F ROOM AIR AND 30 PSI STEAM PRESSURE
3 FOR CONTINUATION OF CW MAKE-UP TO COOLING TOWERS SEE Y & D DWG NO 533 314
4 ALL DUCTS ABOVE CEILING TO BE INSULATED
5 HEATING THERMOSTAT IN SURGERY ROOM TO BE REMOTE BULB POTENTIOMETER TYPE WITH 2°F MAXIMUM DIFFERENTIAL
6 ALL AIR CONDITIONING UNITS TO OPERATE WITH 375 SP AT UNITS OUTLET
7 FRESH AIR INTAKE DUCTS TO EACH AIR COND UNIT IN MECH EQUIP RM FROM LOUVERED OPEN
8 DIFFUSER OUTLETS SHALL BE PROVIDED WITH VOLUME DAMPERS
9 HEATING COILS IN AC UNITS TO OPERATE AT 30 PSI STEAM
LIGHTPROOF EXH FAN 100 CFM
SECTION A-A
SCALE 1/4" = 1'-0"
AIR FILTER
GRILLE
275CFM
225CFM
DUTY OR WATCH
MEDICAL STORAGE
CLEANING GEAR
X-RAY
DARK ROOM
SEE ENLARGED VIEW THIS SHEET FOR PIPING CONNECTIONS
MECH EQUIP RM
COOLING TOWER
EXH FAN 300CFM
EXH FAN 100CFM
SPLITTER
CORRIDOR
DIET KITCHEN
SURGERY
STER
STERIL
SICK CALL
MEDICAL OFF
RECORDS
TO MORGUE FOR CONT SEE Y & D DWG NO 537 201
AIR DIFFUSERS (TYPICAL)
QUIET ROOM
PHARMACY
LAB
DENTAL OFFICER
DENTAL OFFICE
20000BTU
EXH FAN 200CFM
NOTE: ALL RADIATOR STEAM CONNS & CONNS RETURN
PLAN
SCALE 1/4" = 1'-0"
PRV 100 TO 30# PSI
530 GAL. COIL CAP 550CFM, 30 PSI STEAM TO HEAT 60°F WATER TO 150° — SEE NOTE NO. 1
2" STEAM/4" PUMPED RETURN, FOR CONT SEE Y & D DWG NO. 332,700
PLAN OF MECHANICAL EQUIPMENT ROOM
RETURN AIR FILTERS
40" BY 15" GRILLE
1600 CFM RET AIR
DRIP
COOLING TOWER WITH PUMP 100,000 BTU NET REFR.
VENT & OVERFLOW
PUMP AND RECEIVER
SELF CONTAINED AIR COND UNITS 2000 CFM 60,000 BTU NET REFR. EACH 85° CONDENSING WATER, ENT AIR 68° LEAVING AIR 96° F
ELEC TRANSF.
FRESH AIR DUCT
RETURN AIR FILTERS
SELF CONTAINED AIR COND. UNIT 550 CFM 42,300 BTU/HR REFR. EFFECT ENT AIR 100° F, 85° CONDENSING WATER EXT AIR 36° F LEAVING AIR 72° F
FRESH AIR LOUVERED OPENING
DRAIN
13 X 13 550 CFM FRESH AIR INTAKE

Fig 4-24. Air-conditioning system plan.

EXERCISE: Refer to figure 4-24 to answer the following questions. Compare your responses with the answers listed at the end of the study unit.

1. What is the smallest size duct used in the air-conditioning system?

2. Are typical air diffusers used to supply air to the surgery room?

3. Is any conditioned air being forced into the diet kitchen?

4. What is the rate of conditioned air being supplied to X-ray?

5. What is the rate of conditioned air being supplied to the duty or water room?

6. What size duct is designated for the quiet room?

SUMMARY REVIEW

In the preceding work units you have learned about utility, heating, and air-conditioning plans. Now you can identify the electrical, plumbing, heating, and air conditioning symbols and abbreviations. You can also read and interpret electrical, plumbing, heating and air conditioning plans and detail drawings. You can recognize and name the two types of hot-water heating sytems: the one-pipe system and two-pipe system. You can also define the comfort zone as the horizontal area from a man's head to his knees.

Answers to Study Unit #4 Exercises

Work Unit 4-1.

1. three-way switch
2. ceiling light outlet
3. thermostat
4. Incoming service lines
5. continuous-row fluorescent fixture
6. branch circuit home run to panel board
7. Special purpose outlet

Work Unit 4-2.

1. Access Panel
2. Circuit Breaker
3. Direct Current
4. Grounded
5. Meter
6. Negative
7. Outlet
8. Pull Switch
9. Single Pole
10. Utility Room

Work Unit 4-3.

1. A1
2. A5
3. A4
4. 800 watts
5. 590 watts
6. 600 watts
7. A6

Work Unit 4-4.

1. Leader, soil or waste (above grade)
2. gas line
3. Outlet turned up
4. hose valve
5. Check valve
6. shower heads, gang
7. Corner lavatory
8. shower stall

Work Unit 4-5.

1. Area Drain
2. Cast Iron
3. Clean Out
4. Hose Bibb
5. Lavatory
6. Plumbing
7. Roof Drain
8. Shower
9. Urinal
10. Water Closet

Work Unit 4-6.

1. 3/4" tile pipe
2. Eight (8)
3. Two inch
4. Four inch
5. False
6. Four inch
7. 3/4-inch x 1/2-inch bushing

Work Unit 4-7.

1. 10" x 24" duct
2. wall radiator
3. Thermostat
4. 18" diameter ceiling supply outlet
5. Compressor
6. High Pressure Steam
7. circulating chilled or hot-water flow
8. Cross feed
9. Forced convection cooling unit

Work Unit 4-8.

1. Air Conditioning
2. Cold Air
3. Diameter
4. Exhaust
5. Forced Air
6. Supply Air
7. Register
8. Hot Water
9. Hot Air
10. Steam

Work Unit 4-9.

1. one-pipe, two-pipe
2. One-pipe
3. Two-pipe
4. one-pipe
5. two-pipe

Work Unit 4-10.

1. knees
2. 12" x 12"
3. 10" x 6"
4. 12" x 6"
5. 10" x 6"
6. 28" x 16"

Work Unit 4-11.

1. 6" x 6"
2. No. The air to the surgery room must pass through 20-inch by 10-inch x 2-inch air filters.
3. No. Only an exhaust fan is used in the diet kitchen.
4. 300 CFM
5. 225 CFM
6. 8" x 8"

CONSTRUCTION PRINT READING

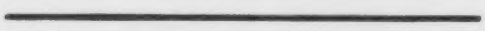
Review Lesson

Instructions: This review lesson is designed to aid you in preparing for your final exam. You should try to complete this lesson without referring to the course text or other materials, but if you find that you must use the materials to answer some of the questions, do so. The enclosed answer sheet must be filled out according to the instructions on the back of the sheet and mailed to MCI using the envelope provided. If you answer any items incorrectly, they will be listed with the appropriate reference on a feedback sheet which will be mailed to your commanding officer with your final exam. You should study the referenced material for the questions you missed before taking the final exam.

A. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

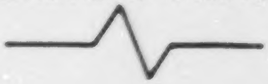
Value: 1 point each

1. What line convention is illustrated?



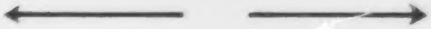
a. Visible	c. Center
b. Dimension	d. Break

2. What line convention is illustrated?



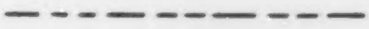
a. Center	c. Phantom
b. Dimension	d. Break (long)

3. What line convention is illustrated?



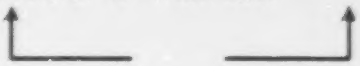
a. Break	c. Dimension
b. Stitch	d. Cutting

4. What line convention is illustrated?



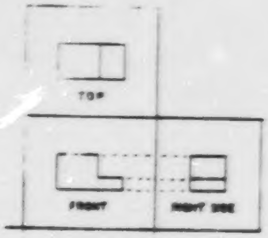
a. Phantom	c. Stitch
b. Extension	d. Center

5. What line convention is illustrated?



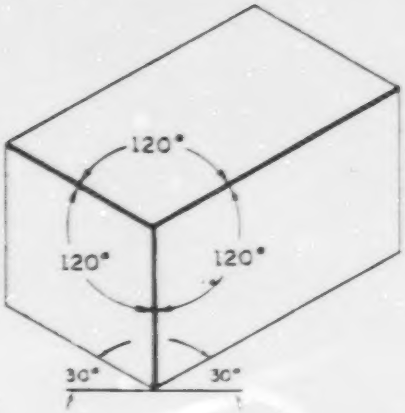
a. Phantom	c. Leader
b. Cutting	d. Hidden

6. The three-view drawing illustrated below is an example of what type projection?


TOP
FRONT
RIGHT SIDE

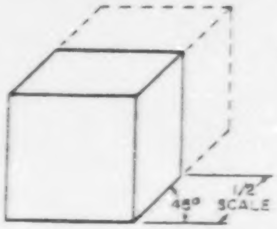
a. Cabinet
b. Orthographic
c. Oblique
d. Section

7. What type of drawing is illustrated?


120°
120°
120°
30°
30°

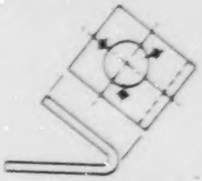
a. Section
b. Oblique
c. Isometric
d. Cabinet

8. The illustration below is an example of a(an) ______________________ drawing.



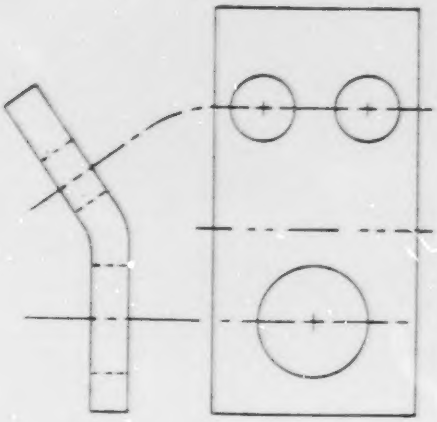
a. oblique
b. auxiliary
c. isometric
d. section

9. What view is illustrated in the drawing below?



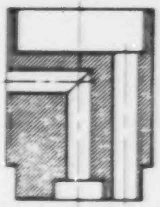
a. Auxiliary
b. Side
c. Section
d. Phantom

10. The illustration below is an example of a(an) ____________________ view.



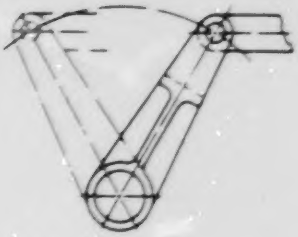
a. offset
b. revolved
c. side
d. rotation

11. The drawing illustrated is an example of a(an) ________________ view.



a. oblique
b. phantom
c. section
d. rotation

12. The illustration below is an example of what type of view?



a. Full section
b. Phantom
c. Alined
d. Auxiliary

13. Two of the three types of prints are optical processes and positive contact processes. What is the third process?

a. Construction
b. Removed
c. Intermediate
d. Negative contact

14. Construction prints should be folded so that the drawing number is always ______________.

a. visible.
b. at the top.
c. on the bottom.
d. inside.

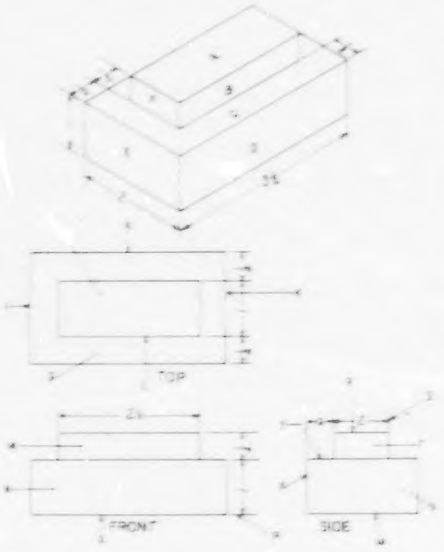
15. The four parts that may be found on a print are title block, revision block, bill of materials, and ______________________________.

a. notes and specifications.
b. drawn size.
c. architect's name.
d. production number.

16. The two classifications of military drawings are construction and ______________.

a. specification.
b. production.
c. application.
d. interpretation.

Note: Questions 17 through 20 are based on the drawing below.



17. What surface in the top view represents A in the isometric view?

    a. J
    b. G
    c. X
    d. H

18. Surface B in the isometric view is represented by what surface in the front view?

    a. N
    b. M
    c. P
    d. O

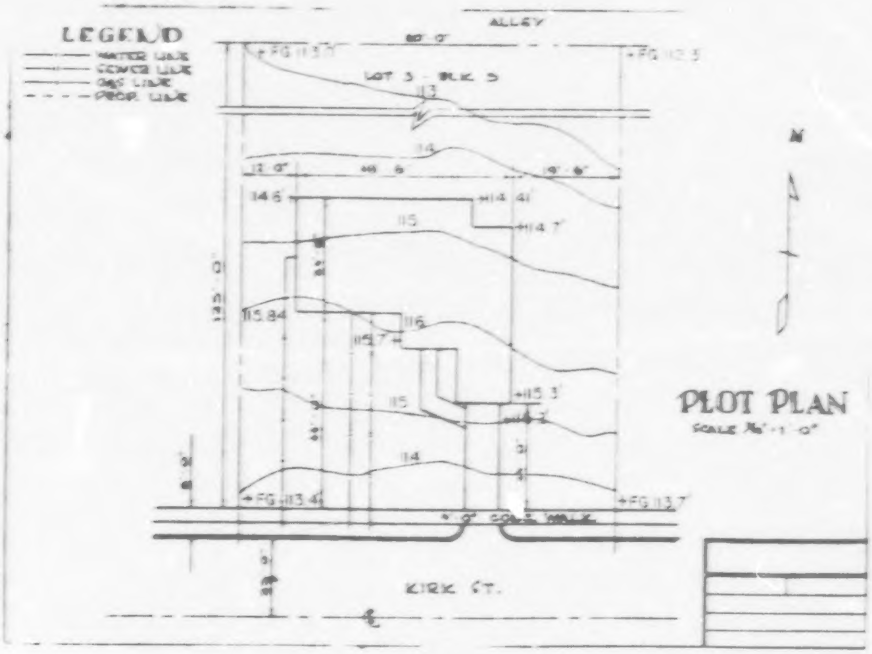
19. Surface L in the front view represents what surface in the isometric view?

    a. B
    b. C
    c. F
    d. D

20. Surface E in the isometric view is represented by what surface in the side view?

    a. U
    b. W
    c. V
    d. T

Note: Questions 21 through 24 are based on the plot plan shown below.


LEGEND
WATER LINE
SEWER LINE
GAS LINE
PROP. LINE
ALLEY
80'-0"
FG 113.7'
FG 112.5'
LOT 3 - BLK 5
113
114
12'-0"
48'-6"
19'-6"
114.6'
114.41'
115
114.7'
125'-0"
115.84
116
115.7'
115.3'
115
114
FG 113.4'
FG 113.7'
4'-0" CONC. WALK
KIRK ST.
PLOT PLAN
SCALE 1/16"=1'-0"

21. What is the finished grade at the northwest corner of the property line?

a. 113.4'	c. 113.0'
b. 115.8'	d. 114.6'

22. How many feet from the west property is the house located?

a. 114.6'	c. 19'-6"
b. 12'-0"	d. 48'-6"

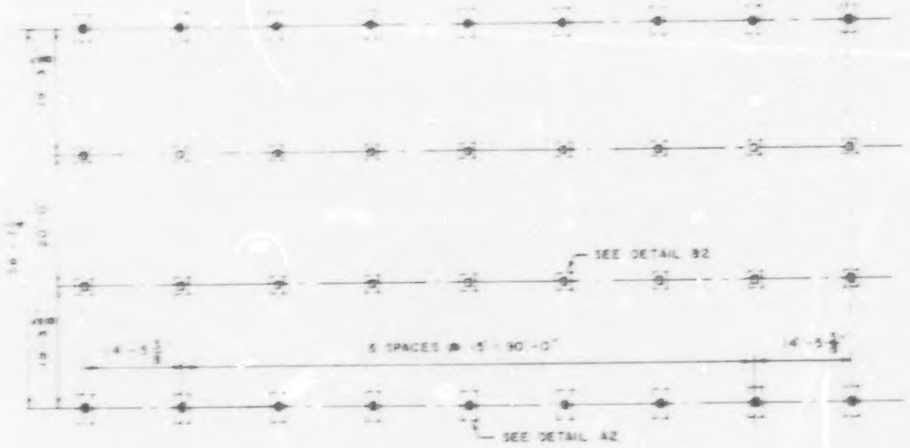
23. What is the distance from the south end of the garage to the 4'-0" concrete walk?

a. 115.2'	c. 44'-0"
b. 24'-8"	d. 24'-0"

24. What is the length of the north property line?

a. 80'-0"	c. 48'-6"
b. 125'-0"	d. 113.0'

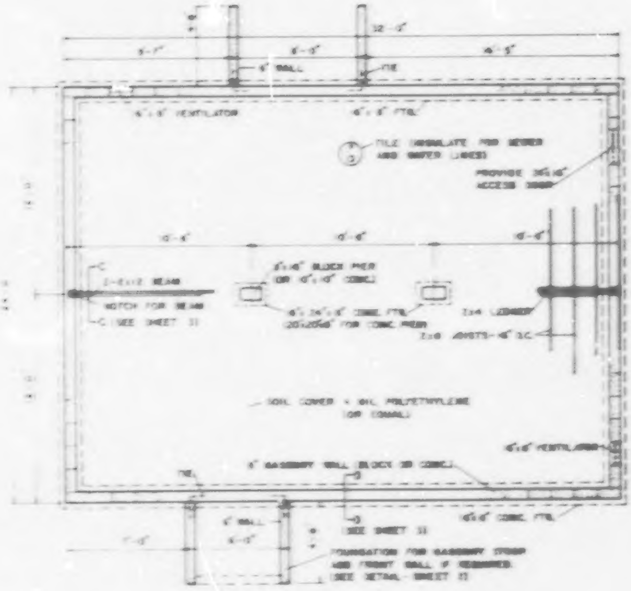
25. What type of foundation is illustrated in the drawing below?



SEE DETAIL B2
SEE DETAIL A2

a. Wall
b. Column
c. Concrete block
d. Earth

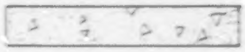
26. The illustration below is an example of a(an) ________________ foundation plan.



8" WALL
TIE
VENTILATOR
TILE (INSULATE FOR SEWER AND WATER LINES)
PROVIDE ACCESS DOOR
BLOCK PIER
NOTCH FOR BEAM
(SEE SHEET 3)
2x4 LEDGER
JOISTS-16" O.C.
SOIL COVER 4 MIL POLYETHYLENE
8" MASONRY WALL (BLOCK OR CONC.)
CONC. FTG.
FOUNDATION FOR MASONRY STOOP AND FRONT WALL IF REQUIRED. (SEE DETAIL-SHEET 3)

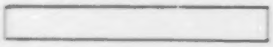
a. post
b. column
c. wall
d. steel

27. What material is represented by the symbol illustrated?



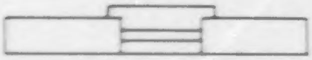
a. Brick
b. Wood
c. Concrete
d. Earth

28. What material is represented by the symbol illustrated?



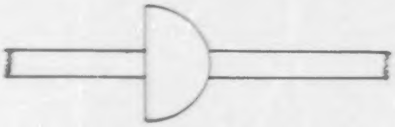
a. Tile
b. Glass block
c. Stone on brick
d. Wood stud partition

29. The symbol illustrated is the symbol for a(an) ______________________.



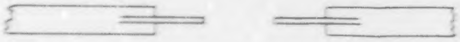
a. double-hung window.
b. single door.
c. out-swinging casement window.
d. sliding door.

30. The illustration shown is the symbol for a(an) ______________________.



a. in-and-out door.
b. double-acting single door.
c. sliding door.
d. single out-swinging window.

31. What type of door is represented by the symbol illustrated?



a. Refrigerator
b. Double, opening in
c. Single, interior
d. Sliding doors

B. Matching: In the group of items below (items 32 through 34), match the abbreviation in column 1 with the applicable term in column 2. In each group select the letter indicating your choice (a, b, c, d, or e). After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Column 1

Abbreviations

32. FR

33. BR

34. REC

Column 2

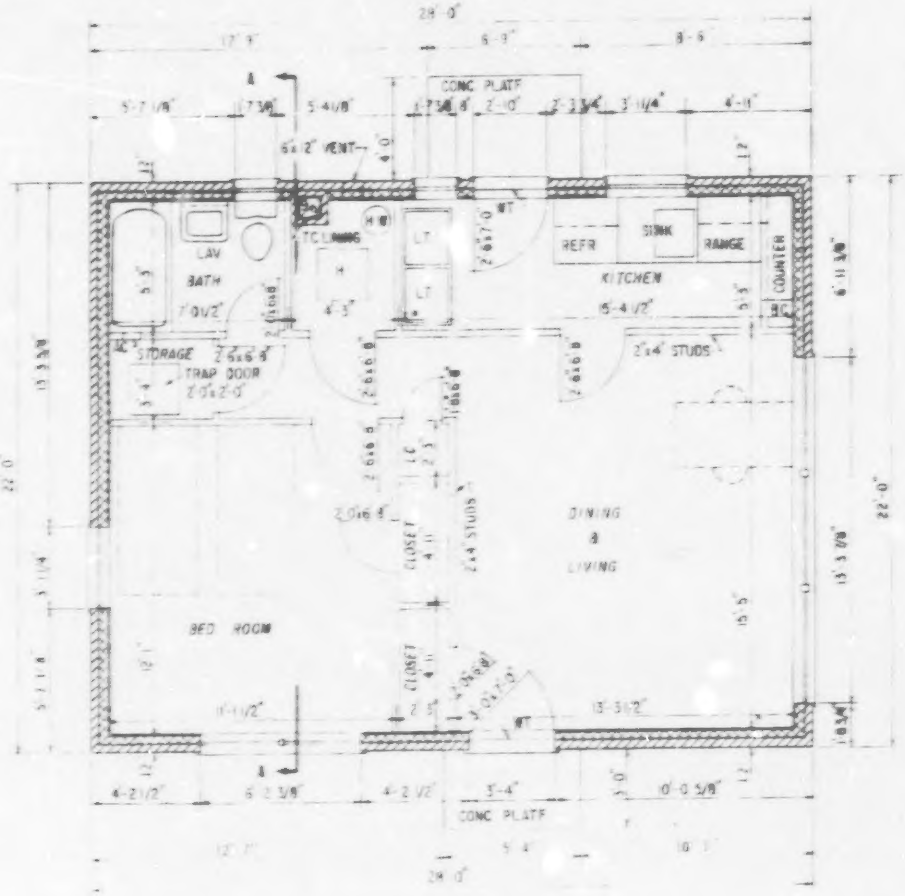
Terms

a. Bedroom
b. Recessed
c. Frame
d. Blue print
e. Floor

C. Multiple Choice: Select the ONE that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Note: Questions 35 through 39 are based on the floor plan illustrated below.


28'-0"
12'-9"
6'-9"
8'-6"
CONC. PLATF
5'-7 1/8"
5'-4 1/8"
2'-10"
4'-11"
6x12" VENT
LAV
BATH
7'-0 1/2"
5'-3"
TC LINING
H.W.
H
4'-3"
LT
WT
REFR
SINK
RANGE
KITCHEN
COUNTER
BC
15'-4 1/2"
2x4" STUDS
STORAGE
TRAP DOOR
2'-0x2'-0"
DINING
&
LIVING
CLOSET
BED ROOM
11'-1 1/2"
13'-3 1/2"
15'-5"
22'-0"
4'-2 1/2"
6'-2 3/8"
3'-4"
10'-0 5/8"
CONC. PLATF
12'-7"
5'-4"
10'-1"
28'-0"

35. What are the dimensions of the living/dining room?

a. 5'-3" x 7'-0 1/2"
b. 5'-3" x 15'-4 1/2"
c. 11'-1 1/2" x 12'-1"
d. 13'-3 1/2" x 15'-5"

36. What are the dimensions of the bathroom?

a. 3'-4" x 4'-2 1/2"
b. 5'-3" x 7'-0 1/2"
✓ c. 11'-11 1/2" x 12'-1"
d. 13'-3 1/2" x 15'-5"

37. The dimensions of the bedroom are ______________________________.

a. 11'-1 1/2" x 12'-1".
b. 5'-3" x 7'-0 1/2".
c. 4'-3" x 5'-3".
d. 3'-4" x 4'-2 1/2".

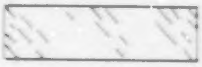
38. The 4'-3" by 5'-3" space between the bathroom and kitchen is used

a. for the laundry area.
b. to store the air-conditioning system.
c. to store the hot-water heater and heating unit.
d. as a spare bedroom.

39. What are the number of stories in the house shown on the floor plan?

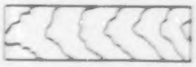
a. 2
b. 1 1/2
c. 1
d. 0

40. What is represented by the symbol illustrated?



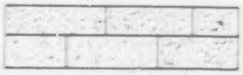
a. Glass
b. Wood
c. Wire mesh
d. Brick

41. The symbol below represents what material?



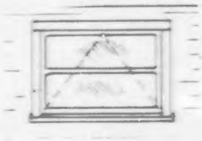
a. Ceramic tile
b. Wood panel
c. Asphalt shingles
d. Concrete block

42. The symbol illustrated represents ____.



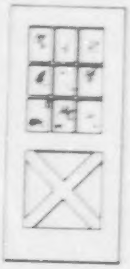
a. stucco.
b. concrete block.
c. asphalt shingles.
d. wood panel.

43. What type of window is represented by the symbol illustrated?



a. Sliding
b. Casement
c. Awning, hinged at top
d. Double hung

44. The symbol illustrated represents a(an)



a. flush door.
b. sliding door.
c. folding door.
d. panel door.

D. Matching: In the group of items below (items 45 - 47), match the abbreviation in column 1 with the applicable term in column 2. In each group select the letter indicating your choice (a, b, c, d, or e). After the corresponding number on the answer sheet, blacken the appropriate circle.

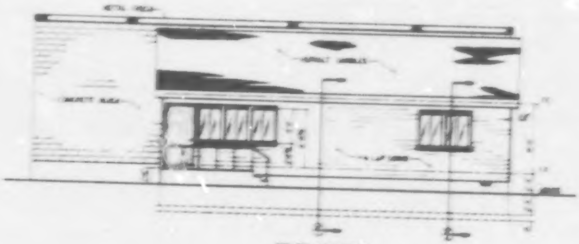
Value: 1 point each

Column 1 Abbreviations	Column 2 Terms
45. IN	a. Drawing
	b. Insulated
46. DWG	c. Sheet
	d. Inch or Inches
47. SH	e. Sheathing

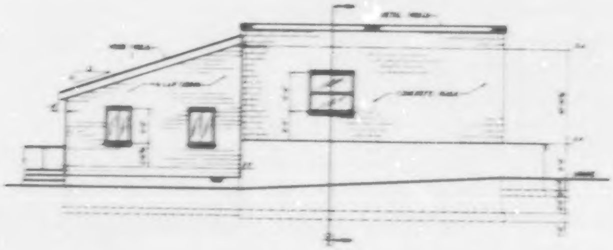
E. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Note: Questions 48 through 52 are based on the elevation drawing shown.



SOUTH ELEVATION



EAST ELEVATION

48. What type of roof is indicated on the frame portion of the building shown?

a. Flat
b. Hip
c. Shed
d. Gable

49. What roof slope is indicated on the frame portion of the building shown?

a. 4 in 12
b. 4 in 0
c. 1 in 6
d. 1 in 0

50. What type of window is indicated on the frame section of the east elevation view?

a. Casement
b. Double hung
c. Awning
d. Horizontal sliding

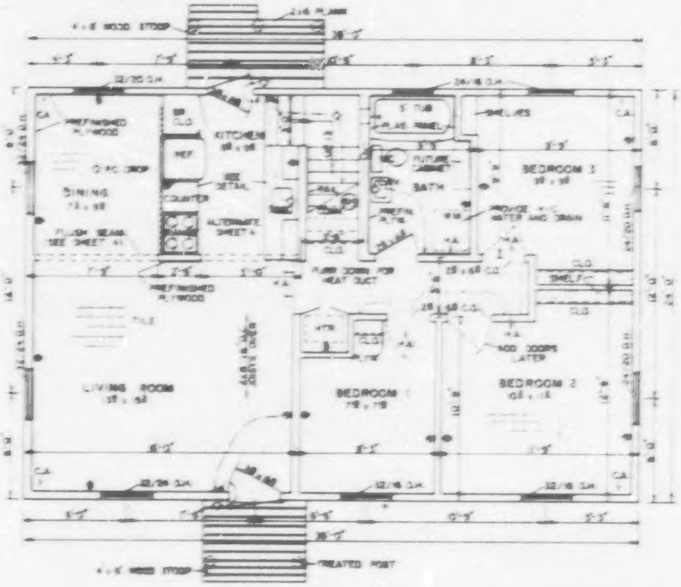
51. What type of door is indicated on the south elevation view?

a. Folding
b. French
c. Panel
d. Flush

52. What type of finish material is indicated for exterior of the frame portion of the building?

a. Tongue and groove
b. 1" x 6" lap siding
c. Vinyl siding
d. Aluminum siding

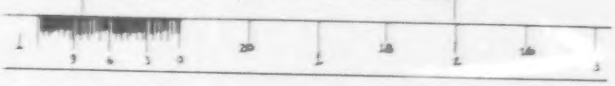
53. The scale used on the floor plan below is ____________________.


4 x 6 WOOD STOOP
2x6 PLANK
32/20 D.H.
24/16 D.H.
C.A.
PREFINISHED PLYWOOD
KITCHEN
REF
DINING
COUNTER
SEE DETAIL
ALTERNATE SHEET 4
FLUSH BEAM SEE SHEET 4
5' TUB
PLAS. PANEL
SHELVES
FUTURE CABINET
BATH
PREFIN. PLYWD.
BEDROOM 3
PROVIDE W/C WATER AND DRAIN
CLO.
FURR DOWN FOR HEAT DUCT
SHELF
TILE
LIVING ROOM
BEDROOM 1
BEDROOM 2
ADD DOORS LATER
32/24 D.H.
32/16 D.H.
TREATED POST

FIRST FLOOR PLAN
SCALE 1/4" = 1'-0"

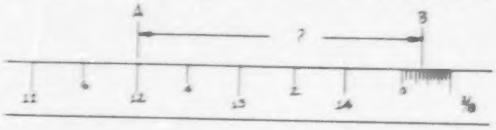
a. 1' = 1'-0"
b. 3/4' = 1'-12"
c. 1/4' = 1'-12"
d. 1/4" = 1'-0"

54. The dimension between A and B on the illustration is



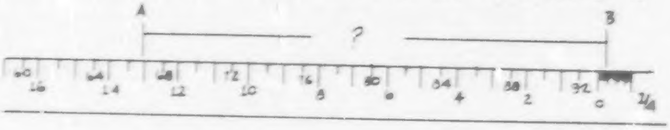
a. 17'-8 1/2".
b. 2'-18".
c. 2'-8 1/4".
d. 2'-6 1/2".

55. What is the dimension between A and B on the illustration shown?


A
?
B
11
12
13
14
1/8

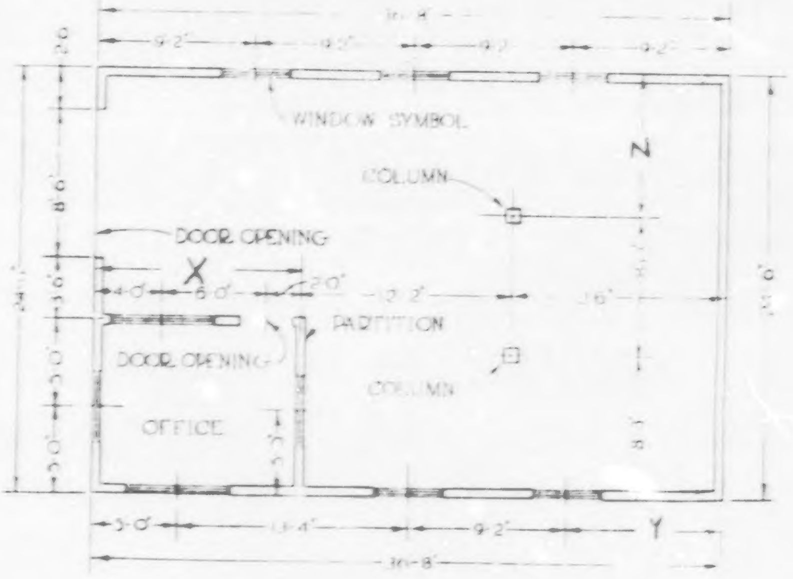
a. 5'-2 1/2"
b. 5'-5"
c. 12'-2 1/2"
d. 12'-5"

56. The dimension between A and B on the illustration is


A
?
B
60
16
64
14
68
12
72
10
76
8
80
6
84
4
88
2
92
0
1/4

a. 13'-3".
b. 13'-6".
c. 67'-3".
d. 69'-6".

__Note:__ Questions 57 through 59 refer to the following illustration.


36'-8"
9'-2"
9'-2"
9'-2"
9'-2"
WINDOW SYMBOL
Z
COLUMN
DOOR OPENING
X
4'-0"
6'-0"
2'-0"
12'-2"
PARTITION
DOOR OPENING
COLUMN
OFFICE
5'-0"
13'-4"
9'-2"
Y
36'-8"

57. The unknown dimension at point X is

a. 2'-0". c. 6'-0".
b. 4'-6". d. 12'-0".

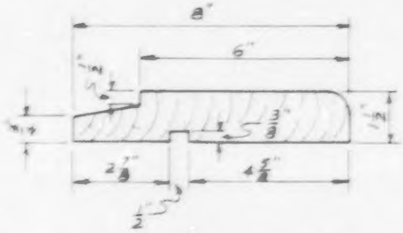
58. What is the unknown dimension at Y?

a. 4'-2" c. 9'-2"
b. 5'-0" d. 13'-4"

59. The unknown dimension at point Z is

a. 3'-8". c. 16'-3".
b. 8'-3". d. 24'-6".

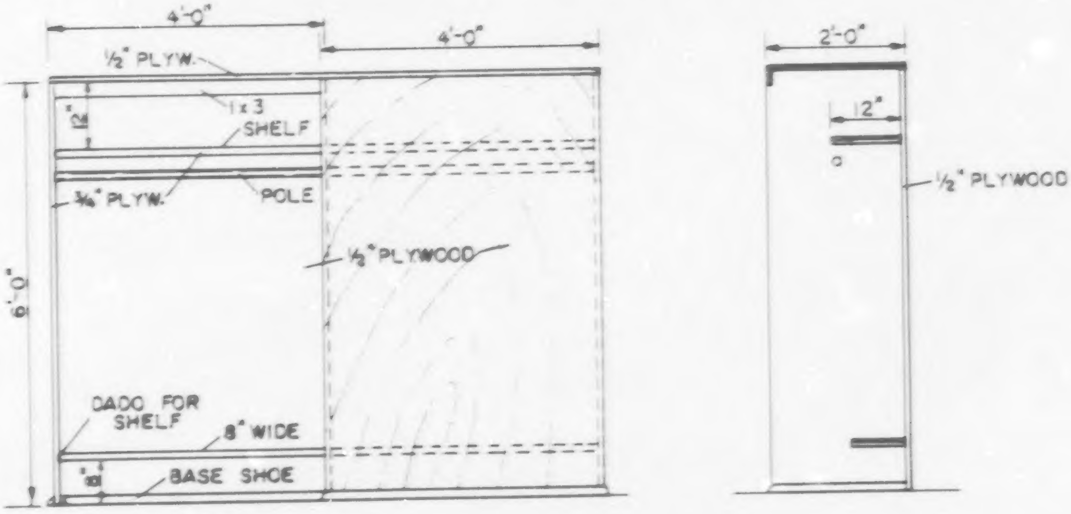
60. The scale used on the sliding door sill detail illustrated is


8"
6"
3/8"
1/2"
2 7/8"
4 5/8"
1/2

SLIDING DOOR
SILL DETAIL
SCALE: 3"=1'-0"

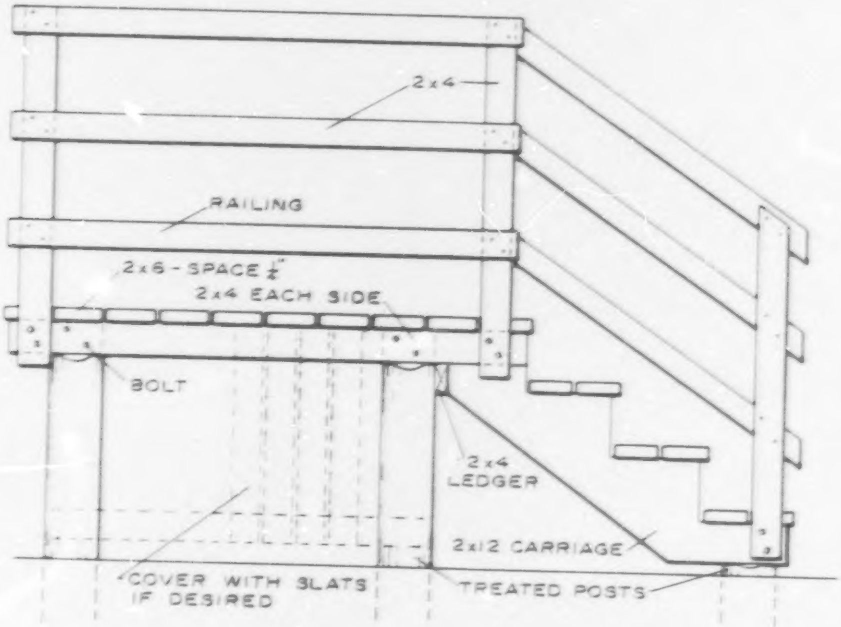
a. 1" = 0'-1". c. 3" = 1'-0".
b. 1" = 1'-0". d. 3" = 1'-1".

61. The interior detail drawing illustrated is a(an)


4'-0"
4'-0"
2'-0"
1/2" PLYW.
1x3
12"
SHELF
3/4" PLYW.
POLE
1/2" PLYWOOD
6'-0"
DADO FOR SHELF
8" WIDE
BASE SHOE
12"
1/2" PLYWOOD

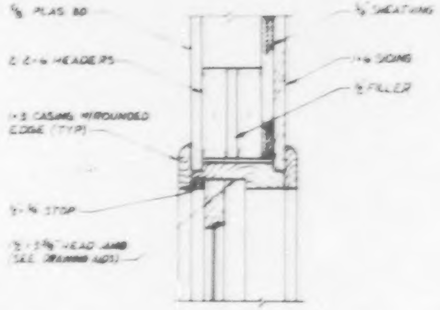
a. bathroom. c. clothes closet.
b. kitchen cabinet. d. tool storage locker.

62. The exterior detail drawing illustrated is a(an)


2×4
RAILING
2×6 - SPACE 1/4"
2×4 EACH SIDE
BOLT
2×4
LEDGER
2×12 CARRIAGE
COVER WITH SLATS
IF DESIRED
TREATED POSTS

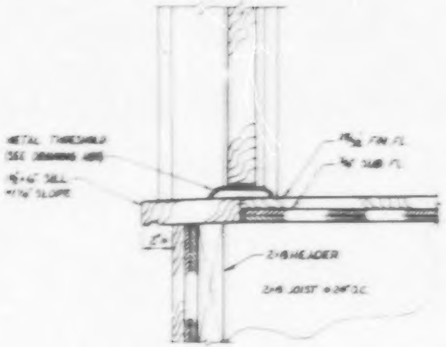
a. set of steps and landing.
b. loading dock.
c. security fence.
d. gable end over-hang.

63. The drawing illustrated is a(an)


5/8 PLAS BD
2 2×6 HEADERS
1×3 CASING W/ROUNDED
EDGE (TYP)
1/2×3/4 STOP
1/2×5 3/4" HEAD JAMB
(SEE DRAWING NOS)
1/2" SHEATHING
1×6 SIDING
1/2 FILLER

a. window jamb detail.
b. windowsill detail.
c. door side detail.
d. window head detail.

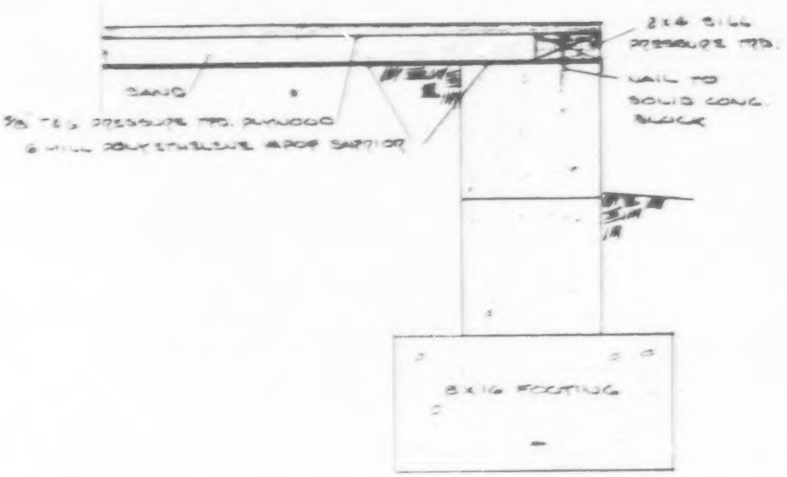
64. What type of detail drawing is illustrated?


METAL THRESHOLD
SEE DRAWING
2×8 HEADER
2×8 JOIST @ 24" O.C.

a. Window jamb
b. Doorsill

c. Doorhead
d. Doorjamb

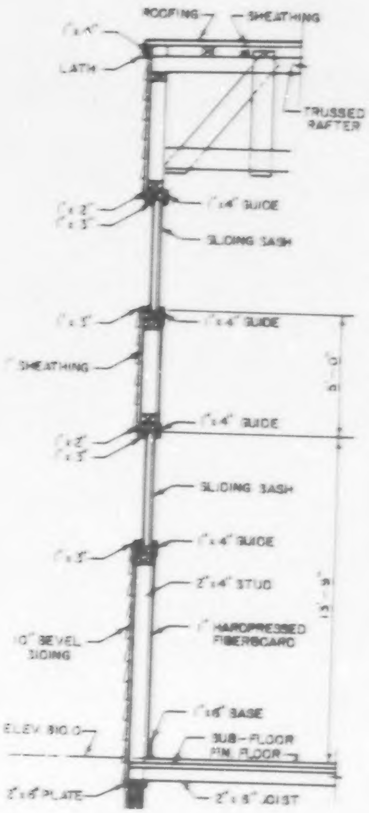
65. The section view illustrated is of a(an)


2x4 SILL
PRESSURE TRD.
NAIL TO
SOLID CONC.
BLOCK
SAND
5/8" T&G PRESSURE TRD. PLYWOOD
6 MILL POLYETHYLENE VAPOR BARRIER
8x16 FOOTING

a. foundation plan.
b. exterior wall.

c. interior wall.
d. window frame.

Note: Questions 66 through 69 refer to the following illustration.


ROOFING
SHEATHING
1" x 4"
LATH
TRUSSED RAFTER
1" x 2"
1" x 3"
1" x 4" GUIDE
SLIDING SASH
1" x 3"
1" x 4" GUIDE
1" SHEATHING
1" x 4" GUIDE
1" x 2"
1" x 3"
SLIDING SASH
1" x 3"
1" x 4" GUIDE
2" x 4" STUD
10" BEVEL SIDING
1" HARDPRESSED FIBERBOARD
1" x 6" BASE
ELEV. 810.0
SUB-FLOOR
FIN. FLOOR
2" x 6" PLATE
2" x 8" JOIST

66. What type of windows are indicated?

    a. Fixed
    b. Sliding sash
    c. Double hung
    d. Awning

67. What size material is used for the floor joist?

    a. 1" x 2"
    b. 1" x 4"
    c. 2" x 6"
    d. 2" x 8"

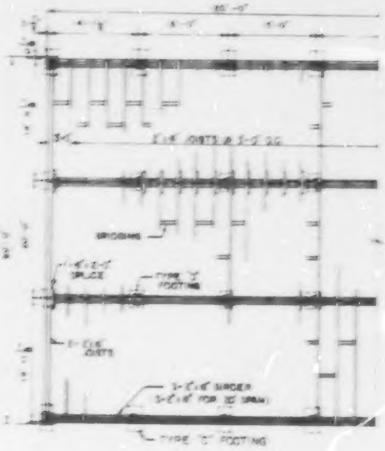
68. What material is used for the finished interior wall?

    a. 10" bevel siding
    b. 1" sheathing
    c. 2" x 4" studding
    d. 1" hardpressed fiberboard

69. What is used for exterior finish?

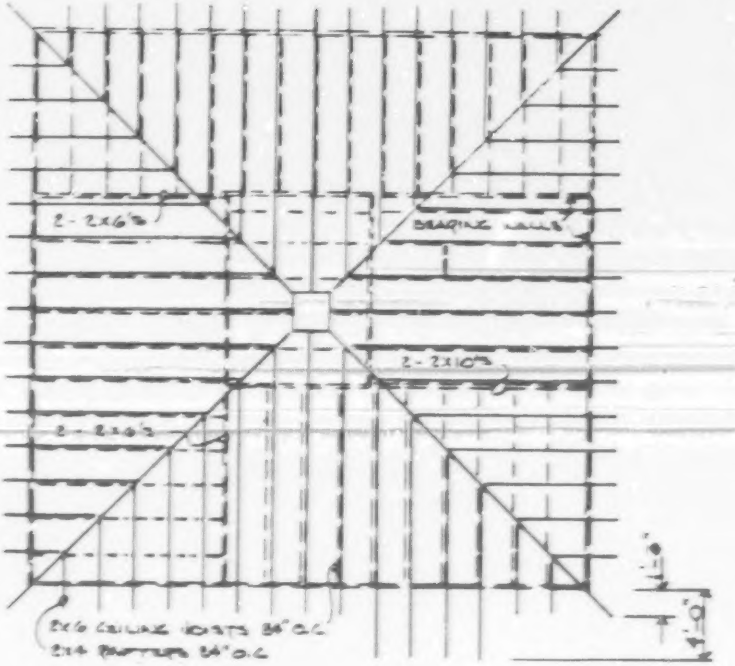
    a. 1" x 4" guide
    b. 10" bevel siding
    c. 1" x 6" base
    d. 1" sheathing

70. What type of framing plan is illustrated?


BRIDGING
SPLICE
FOOTING
TYPE "C" FOOTING

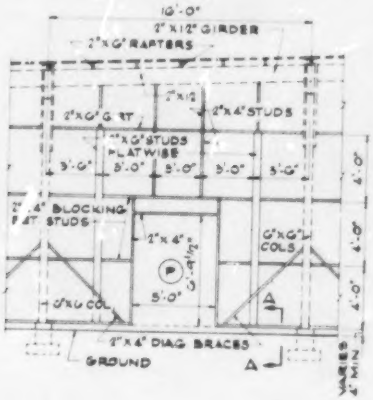
a. Wall
b. Floor
c. Roof
d. Ceiling

71. The drawing illustrated is a(an)


2 - 2x6's
BEARING WALLS
2 - 2x10's
2 - 2x6's
2x6 CEILING JOISTS 24" O.C.
2x4 RAFTERS 24" O.C.

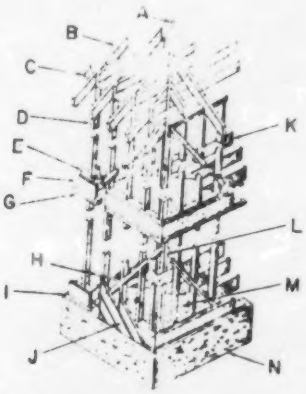
a. elevation view of a wall.
b. roof framing plan.
c. section view of an interior partition.
d. floor framing plan.

72. The drawing illustrated is a(an)


10'-0"
2" X 12" GIRDER
2" X 6" RAFTERS
2" X 12
2" X 6" GIRT
2" X 4" STUDS
2" X 6" STUDS FLATWISE
3'-0"
5'-0"
5'-0"
5'-0"
5'-0"
4'-0"
4'-0"
4'-0"
2" X 4" BLOCKING FLAT STUDS
2" X 4"
6'-4 1/2"
5'-0"
6" X 6" COLS
6" X 6" COL
2" X 4" DIAG BRACES
GROUND
A
A
VARIES 2' MIN

a. ceiling layout.
b. elevation view of a site plan.
c. wall framing plan.
d. roof framing layout.

Note: Questions 73 through 77 refer to the following illustration.


A
B
C
D
E
F
G
H
I
J
K
L
M
N

73. The type of construction framing used in the illustration is ______________________.

a. balloon.
b. plank.
c. platform.
d. braced.

74. The structural member at location B is a(an)

a. rafter.
b. stud.
c. joist.
d. corner post.

75. The structural member at location K is a(an)

a. sill.
b. top plate.
c. stud.
d. joist.

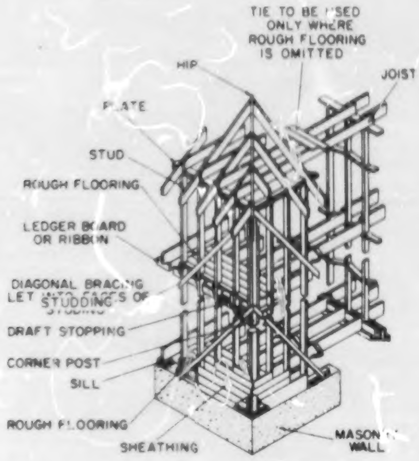
76. What structural member is at location D?

a. Stud
b. Joist
c. Sill
d. Header

77. What structural member is indicated at location G?

a. Top plate
b. Sill
c. Rafter
d. Diagonal brace

78. The illustration shown is an example of a ______________________ frame drawing.

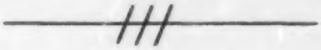

TIE TO BE USED ONLY WHERE ROUGH FLOORING IS OMITTED
HIP
JOIST
PLATE
STUD
ROUGH FLOORING
LEDGER BOARD OR RIBBON
DIAGONAL BRACING LET INTO FACES OF STUDDING
DRAFT STOPPING
CORNER POST
SILL
ROUGH FLOORING
SHEATHING
MASONRY WALL

a. western
b. braced
c. plank
d. balloon

79. The major difference between balloon framing and platform framing is rafters which run from the sill to the

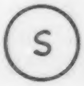
a. rafters.
b. joists.
c. bracing.
d. header.

80. What is represented by the electrical symbol illustrated?



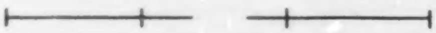
a. Three wires
b. Concealed wire
c. Two wires
d. Wire turned up

81. The electrical symbol illustrated is the symbol for a(an)



a. service switch.
b. ceiling pull switch.
c. pilot lamp.
d. single pole switch.

82. The electrical symbol illustrated is the symbol for a(an)



a. 20-AMP, 250-volt outlet.
b. bare lamp fluorescent strip.
c. wall lighting outlet.
d. continuous row fluorescent fixture.

F. Matching: In the groups below (items 83 through 85) match the abbreviation in column 1 with the applicable term in column 2. In each group select the letter indicating your choice (a, b, c, d, or e). After the corresponding number on the answer sheet, blacken the appropriate circle.

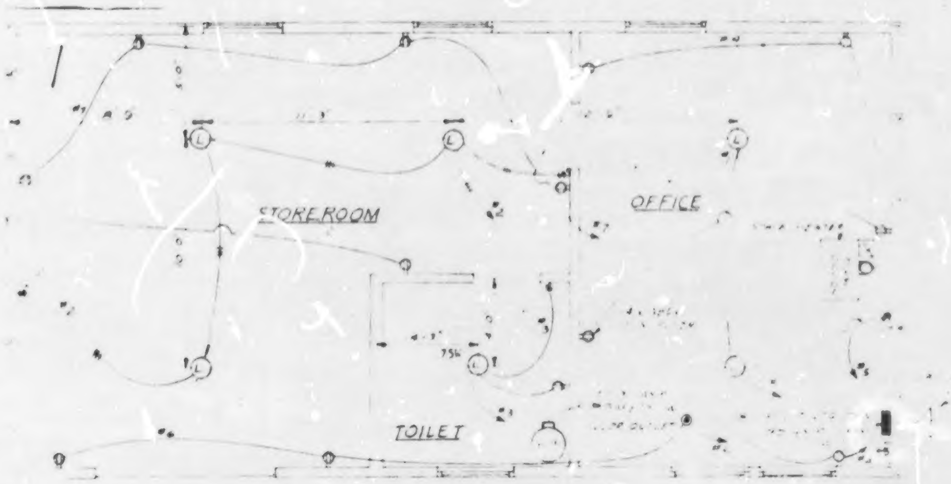
Value: 1 point each

Column 1 Abbreviations	Column 2 Terms
83. SP	a. Outside
	b. Conduit
84. OUT	c. Switch panel
	d. Outlet
85. C	e. Cable

G. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Note: Questions 86 and 87 refer to the following electrical plan.



ELECTRICAL NOTES
1. CONVENIENCE OUTLETS TO BE LOCATED 12" ABOVE FINISHED FLOOR
2. SWITCHES,(LIGHTS) LOCATED 4'-6" ABOVE FINISHED FLOOR.
3. ALL CONVENIENCE OUTLETS TO BE 20[illegible]
4. UNLESS OTHERWISE NOTED ON PLAN ALL LIGHTING TO BE [illegible]

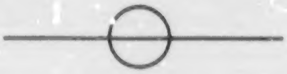
86. The total watts connected to circuit #7 are

a. 1000.
b. 975.
c. 800.
d. 550.

87. The lights in the storeroom are on circuit

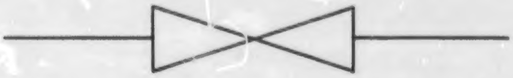
a. #7.
b. #6.
c. #4.
d. #2.

88. The plumbing symbol illustrated is a(an)



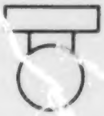
a. turned joint.
b. outlet turned down.
c. outlet turned up.
d. reducer concentric.

89. What is represented by the symbol illustrated?



a. Gate valve
b. Pet cock
c. Hose valve
d. Try cock

90. The plumbing symbol illustrated is a(an)



a. steam table.
b. dishwasher.
c. shower stall.
d. water closet.

H. Matching: In the groups below (items 91 and 92) match the abbreviation in column 1 with the applicable term in column 2. In each group select the letter indicating your choice (a, b, c, d, or e). After the corresponding number on the answer sheet, blacken the appropriate circle.

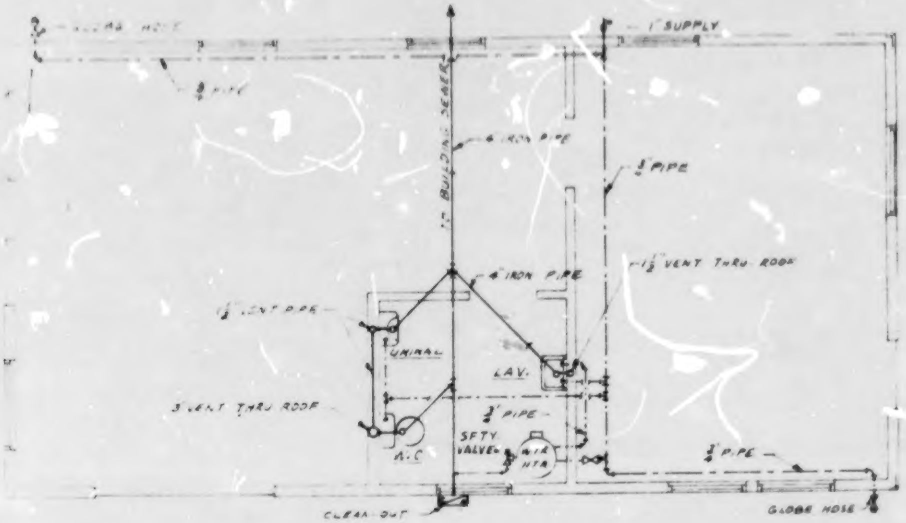
Value: 1 point each

Column 1	Column 2
Abbreviation	Terms
91. WC	a. Cold water
	b. Water closed
92. CW	c. Closed water
	d. Water closet
	e. Cold wash

I. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Note: Questions 93 and 94 refer to the following plumbing plan.


GLOBE HOSE
1" SUPPLY
1/2" PIPE
4" BUILDING SEWER
4" IRON PIPE
1/2" PIPE
1 1/2" VENT THRU ROOF
4" IRON PIPE
1 1/2" VENT PIPE
URINAL
LAV.
3" VENT THRU ROOF
3/4" PIPE
W.C
SFTY. VALVE
W.H. HTR
3/4" PIPE
CLEAN OUT
GLOBE HOSE

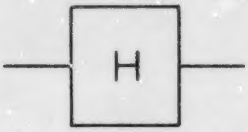
93. The cold water distribution pipe to the urinal is a(an)

a. 1/2" pipe.	c. 1 1/2" pipe.
b. 3/4" pipe.	d. 4" pipe.

94. What size waste pipe is indicated on the plumbing plan?

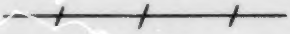
a. 4"	c. 1 1/2"
b. 3"	d. 3/4"

95. The symbol illustrated represents a(an)



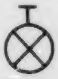
a. propeller-type heater.
b. floor radiator.
c. volume damper.
d. duct-type heater.

96. What heat pipe is represented by the symbol illustrated?



a. Fuel-oil flow
b. Medium pressure steam
c. High-pressure return
d. Compressed air

97. The symbol illustrated represents a(an)



a. magnetic stop valve.
b. hand expansion valve.
c. line filter.
d. snap action valve.

J. Matching: In the groups below (items 98 through 100), match the abbreviation in column 1 with the applicable term in column 2. Select the letter indicating your choice (a, b, c, d, or e). After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Column 1 Abbreviations	Column 2 Terms
98. SA	a. British thermal units
	b. Steam access
99. FA	c. Forced air
	d. Butane tank unit
100. BTU	e. Supply air

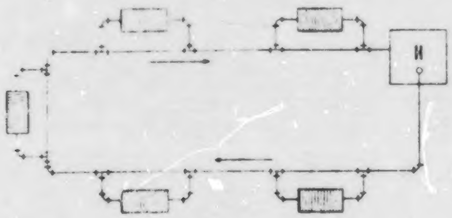
K. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

101. The two types of hot-water heating systems are the one-pipe system and the ______________________________ system.

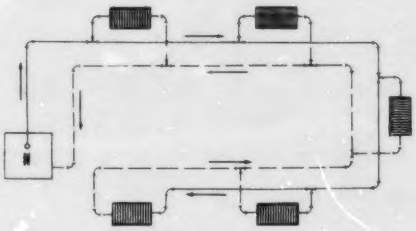
a. forced-air
b. three-pipe
c. cold-supply
d. two-pipe

102. The illustration below is an example of a(an)



a. two-pipe hot-water heating system.
b. warm-air heating system.
c. one-pipe hot-water heating system.
d. forced-air heating system.

103. What type heating system is illustrated?

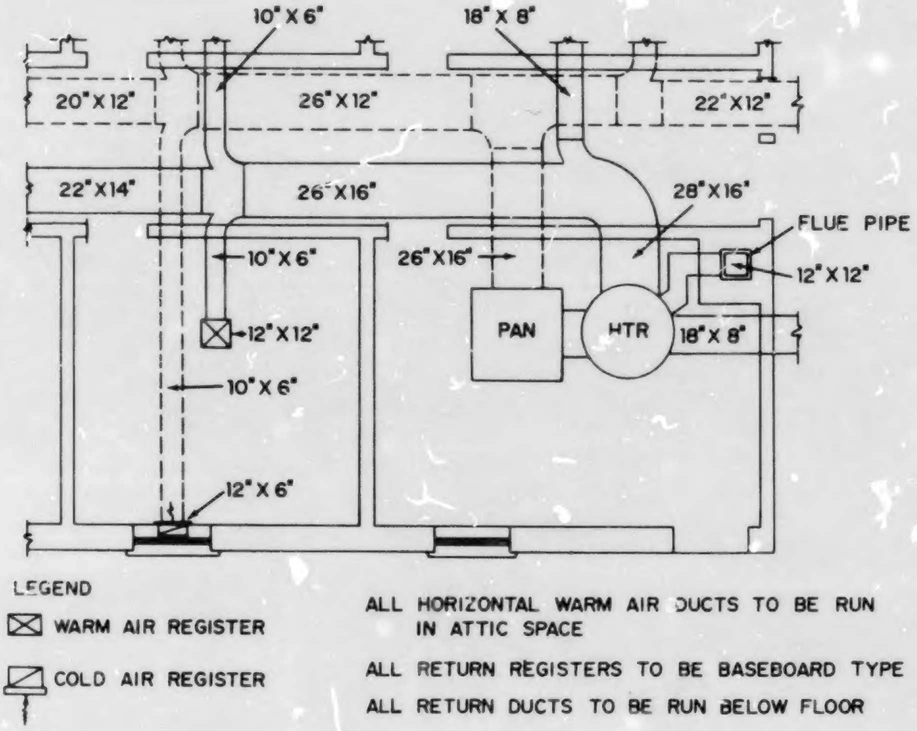


a. Forced coal
b. Two-pipe hot-water
c. Warm-air
d. One-pipe hot-water

104. When referring to a warm-air heating system, the comfort zone is the area from a man's knees to

a. the middle of his chest.
b. the top of his head.
c. the bottom of his feet.
d. the bottom of his head.

Note: Quesions 105 and 106 refer to the following warm-air heating plan.


10" X 6"
18" X 8"
20" X 12"
26" X 12"
22" X 12"
22" X 14"
26" X 16"
28" X 16"
FLUE PIPE
10" X 6"
26" X 16"
12" X 12"
12" X 12"
PAN
HTR
18" X 8"
10" X 6"
12" X 6"
LEGEND
WARM AIR REGISTER
COLD AIR REGISTER

ALL HORIZONTAL WARM AIR DUCTS TO BE RUN IN ATTIC SPACE

ALL RETURN REGISTERS TO BE BASEBOARD TYPE

ALL RETURN DUCTS TO BE RUN BELOW FLOOR

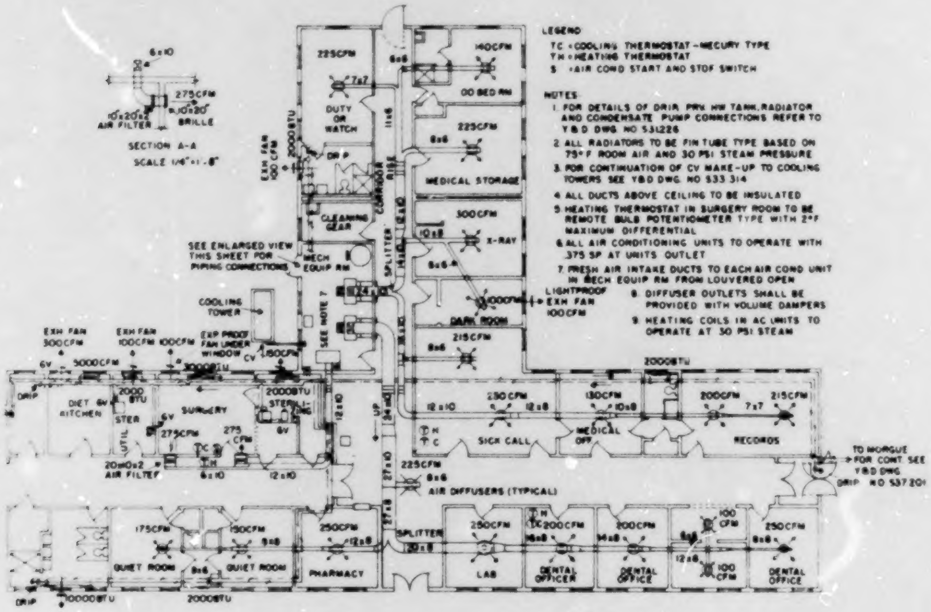
105. What is the largest supply duct attached to the heater?

a. 28" x 16"	c. 18" x 8"
b. 26" x 12"	d. 12" x 12"

106. What is the size of the return air duct where it connects to the pan?

a. 28" x 16"	c. 26" x 12"
b. 28" x 12"	d. 26" x 16"

107. Referring to the illustration of an air conditioning plan, what is the rate of conditioned air.being supplied to the records room?


6x10
275CFM
10x20x2 AIR FILTER
10x20 GRILLE
SECTION A-A
SCALE 1/4"=1'-0"
225CFM
7x7
DUTY OR WATCH
2000BTU
EXH FAN 100 CFM
DRIP
CLEANING GEAR
SEE ENLARGED VIEW THIS SHEET FOR PIPING CONNECTIONS
MECH EQUIP RM
COOLING TOWER
SEE NOTE 7
SPLITTER
CORRIDOR
RISE
6x6
11x6
140CFM
OD BED RM
225CFM
8x6
MEDICAL STORAGE
300CFM
10x8
X-RAY
8x6
100CFM
DARK ROOM
215CFM
8x6
LEGEND
TC = COOLING THERMOSTAT - MECURY TYPE
TH = HEATING THERMOSTAT
S = AIR COND START AND STOP SWITCH
NOTES
1. FOR DETAILS OF DRIP, PRV, HW TANK, RADIATOR AND CONDENSATE PUMP CONNECTIONS REFER TO Y&D DWG NO 531226
2. ALL RADIATORS TO BE FIN TUBE TYPE BASED ON 75° F ROOM AIR AND 30 PSI STEAM PRESSURE
3. FOR CONTINUATION OF CV MAKE-UP TO COOLING TOWERS SEE Y&D DWG NO 533 314
4. ALL DUCTS ABOVE CEILING TO BE INSULATED
5. HEATING THERMOSTAT IN SURGERY ROOM TO BE REMOTE BULB POTENTIOMETER TYPE WITH 2°F MAXIMUM DIFFERENTIAL
6. ALL AIR CONDITIONING UNITS TO OPERATE WITH .375 SP AT UNITS OUTLET
7. FRESH AIR INTAKE DUCTS TO EACH AIR COND UNIT IN MECH EQUIP RM FROM LOUVERED OPEN
8. DIFFUSER OUTLETS SHALL BE PROVIDED WITH VOLUME DAMPERS
9. HEATING COILS IN AC UNITS TO OPERATE AT 30 PSI STEAM
LIGHTPROOF EXH FAN 100CFM
EXH FAN 300CFM
EXH FAN 100CFM
100CFM
EXP PROOF FAN UNDER WINDOW
5000CFM
3000BTU
1150CFM
CV
6V
DRIP
DIET KITCHEN
2000 BTU
STER
UTIL
SURGERY
275CFM
275 CFM
2000BTU
STERILIZ
20x20x2 AIR FILTER
6x10
12x10
12x10
24x10
27x10
27x8
UP
2000BTU
230CFM
12x10
12x8
SICK CALL
130CFM
10x8
MEDICAL OFF
200CFM
7x7
215CFM
RECORDS
TO MORGUE FOR CONT SEE Y&D DWG NO 537 201
DRIP
225CFM
8x6
AIR DIFFUSERS (TYPICAL)
175CFM
150CFM
9x8
8x6
QUIET ROOM
QUIET ROOM
250CFM
12x8
PHARMACY
SPLITTER
20x8
250CFM
LAB
200CFM
16x8
DENTAL OFFICER
200CFM
14x8
DENTAL OFFICE
100 CFM
8x6
12x8
100 CFM
250CFM
8x6
DENTAL OFFICE
DRIP
1000BTU
2000BTU

a. 200 CFM
b. 215 CFM
c. 400 CFM
d. 415 CFM

Total Points: 107

* * *

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T&E-1

STUDENT COURSE CONTENT ASSISTANCE REQUEST

DATE:

COURSE NUMBER	COURSE TITLE	
NAME	RANK	MOS
SOCIAL SECURITY NUMBER		

1. Use this form for any questions you may have about the course. Write out your question and refer to the study unit, work unit, or study question with which you are having problems. Complete the self-addressed block on the reverse side. Before mailing, fold the form and staple it so that MCI's address is showing. Additional sheets may be attached to this side of the form.

MY QUESTION IS:	OUR ANSWER IS:

SIGNATURE (TITLE OR RANK)

STUDENT: Detach and retain this portion.

DATA REQUIRED BY THE PRIVACY ACT OF 1974
(5 U.S.C. 522A)

1. AUTHORITY: Title 5, USC, Sec. 301. Use of your Social Security Number is authorized by Executive Order 9397 of 22 Nov 43.

2. PRINCIPAL PURPOSE: The Student Course Content Assistance Request is used to transmit information concerning student participation in MCI courses.

3. ROUTINE USE: This information is used by MCI personnel to research student inquiries. In some cases information contained therein is used to update correspondence courses and individual student records maintained by the Marine Corps Institute.

4. MANDATORY OR VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION: Disclosure is voluntary. Failure to provide information may result in the provision of incomplete service to your inquiry. Failure to provide your Social Security Number will delay the processing of your assistance request.

INSTRUCTIONS TO STUDENT

1. Fold so that MCI address is outside
2. Insert course number in square marked "Course Number" below
3. Seal with scotch tape or one staple
4. Mail to MCI

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IN THE
UNITED STATES

BUSINESS REPLY MAIL

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UNITED STATES MARINE CORPS
MARINE CORPS INSTITUTE
P. O. BOX 1775
ARLINGTON, VA 22223

STUDENT REQUEST/INQUIRY
MCI - R14 K

DATE SENT: __________
DATE RECEIVED AT MCI: __________

COURSE NUMBER	COURSE TITLE

COMPLETE ALL PORTIONS OF SECTION 1

Section 1. Student Identification

Rank	Initials	Last Name	MOS
SSN	☐☐☐-☐☐-☐☐☐☐	REPORTING UNIT CODE (RUC)	

MILITARY ADDRESS
____
____
ZIP CODE

INSTRUCTIONS: Print or type name, rank, and address clearly. Include ZIP CODE. Only Class III Reservists may use civilian address.

Section 2. CHECK THE APPROPRIATE BOX AND FILL IN THE APPROPRIATE SPACES.

FOR REGULAR AND CLASS II RESERVE MARINES THIS FORM MUST BE SIGNED BY THE COMMANDING OFFICER OR HIS REPRESENTATIVE, i.e. TRAINING NCO.

1. ☐ EXTENSION - Please grant an extension. (Will not be granted if already on extension.)
2. ☐ NOTICE OF COURSE COMPLETION - Final Exam Sent On ____________. (New exam will be sent if exam not received at MCI.)
3. ☐ REENROLLMENT - Student has course materials (See para. 4003 of Vol. I of MCI Catalog for information on reenrollment.)
4. ☐ OVERDUE FINAL EXAM - Last (Review) lesson sent on ___________. Please send exam.
5. ☐ Please send new ANSWER SHEETS.
6. ☐ Please send missing course materials (Not included in course package.)
Lessons____ Manual_____ Other______________
7. ☐ CHANGE - Rank________ Name______________
Social Security Number ☐☐☐-☐☐-☐☐☐☐
RUC ____________
8. ☐ OTHER (explain)______________________
____

FOR MCI USE ONLY
1. D____
2. On SMF____ X____ L ____
3. C____
4. L____
5. Q____
6. P____
7. E____
8. ______________________
____
____

DATE COMPLETED______________________
ORIGINATOR CODE______________________

Note: This form will not be returned by MCI. If request is valid, transaction will show on next UAR or on MCI-R1_ form.

____
SIGNATURE-TITLE OR RANK
(MUST BE CO OR REPRESENTATIVE)

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(5 U.S.C. 522A)

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